# Final Report: Evaluation of the IDEA Public Schools Education Innovation and Research Grant [U411C190117]

## Impact of IDEA Public Schools' Advanced Placement Computer Science Principles Curriculum Study

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# Exhibits

## Project Evaluation Overview

The American Institutes for Research® (AIR®) conducted an external evaluation of IDEA Public Schools' Education Innovation and Research (EIR) grant project Mathways to STEM Success (MSS). The goal of this intervention is to improve student achievement and attainment for high-need students through a two-part intervention that consists of (1) a comprehensive, standards-aligned, educative math curriculum for Grades 6–12 that incorporates vertically aligned computer science standards to increase computer science readiness and (2) increased access to computer science principles (CSP) with curriculum and professional development support. AIR studied the impact of the two interventions implemented as part of the MSS project: the AP Computer Science Support (APCSS) program and the Mathematics Curriculum Redesign. The APCSS intervention was evaluated by implementing a randomized controlled trial (RCT). This report focuses on the evaluation of the APCSS program intervention. A complementary report presents the results of the Math Curriculum Redesign.

In addition, AIR conducted multiple methods of formative and summative evaluation, drawing on multiple data sources, including administrative data, surveys, interviews, focus groups, and documentation, to provide feedback to IDEA Public Schools for ongoing improvement of the implementation of these two interventions and to address the research questions.

### Independence of the Impact Evaluation

AIR independently conducted the impact evaluation. The AIR team was responsible for conducting all key evaluation activities independently, and no staff member on the evaluation team was affiliated with IDEA, the grantee for the project. The impact analyses described here were not subject to the approval of IDEA.

## Background

There were over 500,000 vacant computing jobs across the United States in 2018, but only 35% of U.S. high schools offer computer science classes,[1] and only 8%–10% of STEM graduates study computer science (Code.org, 2018). In 2021, only 5% of all bachelor's degrees conferred were in computer and information sciences (De Brey at al., 2021). The field of STEM is continuing to grow, but the present pipeline is insufficient to meet demand. Student participation in computer science courses during K–12 is the leading indicator for participation in computer science in postsecondary education. The College Board found that students who take Advanced

[1] This number has since grown to 53% of schools in the Unites States (Code.org, 2022).

Placement (AP) Computer Science courses in high school are six times more likely to study computer science in college (Wyatt et al., 2020). Occupations in the field of computer science are some of the highest paying positions across the STEM fields (Carnevale et al., 2015). The disparities in access to computer science pathways for underrepresented racial/ethnic minoritized students and female students contribute to continued inequities and perpetuation of the pay gap. This intervention was intended to address these inequities through strengthening pathways to computer science via the assessment and implementation of computer science curricula.

This intervention was implemented in IDEA Public Schools, a network of charter schools based in Texas. Since 2000, IDEA Public Schools grew from a single campus serving 150 students in the Rio Grande Valley to serving approximately 45,000 students across 79 schools at the time when the EIR grant was awarded in 2019.[2] Of these students, 45.9% are considered to be at risk of dropping out of school, 32.9% are English learners, 88.6% are economically disadvantaged, and 89.2% are minority (Latinx).

IDEA's secondary school model is built on a framework of "AP for All" because peer-reviewed research by ETS, the College Board, the University of Texas, and the U.S. Department of Education all show strong evidence that participation in AP strongly correlates with student achievement, college readiness, and college completion. Making a district-endorsed AP-CSP curriculum available to all secondary schools in IDEA's growing network (rather than allowing each school to choose its own approach to teaching AP-CSP) will advance understanding of how curriculum impacts college and STEM career readiness for underrepresented minority students.

## Intervention and Comparison Conditions

In spring 2021, 30 IDEA high schools were randomly assigned to one of two AP-CSP curricula for the 2021–22 academic year: 15 schools to be in the comparison condition where the code.org curriculum was implemented (this was the business-as-usual AP-CSP curriculum in IDEA high schools at that time); and 15 schools to the treatment condition where an alternative AP-CSP curriculum--the Beauty and Joy of Computing (BJC)[3] was implemented.

BJC is a computer science curriculum that combines teacher professional development with a programming-heavy computer science curriculum to improve students' AP-CSP course taking and test scores. Schools that were assigned to BJC participated in a 1-week training at the beginning of the school year. This training was led by BJC lead teachers who had attended a BJC

[2] According to its website, the network currently serves over 80,000 students in 143 schools across Texas and its affiliates. See https://ideapublicschools.org/our-story/.

[3] The study was conducted only during that academic year. For the 2022–23 academic year, the RCT was not conducted, but the research team collected administrative data to provide descriptive statistics on student enrollment in AP-CSP.

summer professional development workshop, taught the BJC course in high school, and participated in the ongoing "Train the Trainer" professional development program. The workshop content is based on the BJC curriculum but is designed also to prepare teachers for facilitating hands-on programming labs, supporting collaboration in the classroom, and creating equitable opportunities for students to learn computing.

Teachers in the treatment condition then proceeded to teach the BJC curriculum in the 2021–22 academic year. Throughout the year, teachers attended biweekly webinars facilitated by the CS curriculum manager at each school. Teachers were also able to collaborate and communicate through online communication channels.

The BJC curriculum is programming heavy and utilizes a program called Snap!, which is a visual programming language. Specifically, the curriculum provides labs in which students learn computer science concepts and lessons. The goal was to allow students to learn through practice instead of learning through books. Another aspect of the BJC curriculum is that it emphasizes the social implications of computing. For example, the curriculum covers topics such as privacy and search engines, video games and violence, copyright, encryption, and cyberbullying. Finally, the BJC curriculum emphasizes creativity in students' programming projects. Teachers primarily taught with their school's adopted materials in fall 2021 but frequently used other supplementary materials in spring 2022.

Teachers in both the treatment and comparison conditions participated in bi-weekly webinars relevant to the curriculum they were assigned to teach. Additional details about the webinars and other professional development opportunities are described in the qualitative findings section below.

The high schools included in the study had various levels of experience with providing the AP-CSP option. Some schools had never offered the course, some schools had offered it but were not considered "super-users," and some schools had offered AP-CSP and were heavily involved in improving their courses. Schools that were assigned to the comparison condition and had a history of offering AP-CSP used the business-as-usual curriculum, Code.org; schools were randomly assigned in blocks defined by prior experience. Schools that were assigned to the comparison condition and did not have a history of providing AP-CSP were offered a choice of alternative curricula; almost all schools chose to use Code.org. Code.org is a very concept-heavy curriculum, as opposed to BJC being programming heavy. The Code.org curriculum utilizes a platform called App Lab, provides daily lesson plans, and covers topics such as programming, data, art and design, gaming and animation. Most importantly, Code.org connects each lesson to AP topics that could appear on the AP-CSP exam. Teachers in the comparison condition were

not provided with any specific channels through which to communicate with other teachers, nor did they receive any structured ongoing support.

## Research Questions

This study addresses several questions about the impacts of IDEA Public Schools' adoption of the AP-CSP curriculum, BJC, on student outcomes. Specifically, this evaluation answers the following research questions (Exhibit 1):

For one cohort of high school students who enrolled in AP-CSP in the 2021-2022 academic year, what is the effect of the BJC AP-CSP curriculum on

1. Students' AP-CSP test scores compared to business-as-usual AP-CSP curricula?
2. Students' AP-CSP test passing rate compared to business-as-usual AP-CSP curricula?
3. Students' CS attitudes (confidence/interests) and engagement compared with business-as-usual AP-CSP curricula?

### Exhibit 1. Impact Research Questions and Outcome Measures

| Research question[1] | Outcome measure | Outcome domain |
| --- | --- | --- |
| 1. What is the effect of BJC AP-CSP on students' AP-CSP test scores compared to business-as-usual AP-CSP curricula? | AP-CSP test score | Academic Performance<br>Course Performance<br>College Readiness |
| 2. What is the effect of BJC AP-CSP on students' AP-CSP test passing rate compared to business-as-usual AP-CSP curricula? | AP-CSP test score of 3 or above | Academic Performance<br>Course Performance<br>College Readiness |
| 3. What is the effect of BJC AP-CSP on students' CS attitudes (confidence/interests) and engagement compared with the business-as-usual AP-CSP curricula? | Student Survey Responses | Academic Dispositions |

[1] Question 3 is considered exploratory because the survey response rates were very low, and the results cannot be generalized to the randomized student population. A final research question examined the difference between the treatment and comparison schools in enrollment in AP-CSP 1 year after implementation. However, we were not able to measure this outcome using the same impact models as used for research questions 1–2 because the RCT was not implemented after the conclusion of the first year of implementation. Instead, we provide some descriptive information in Appendix E.

## Impact Evaluation Design and Measures

### Design

The AP-CSP impact study was designed as a cluster randomized control trial with random assignment at the school-level. The sample includes one district, IDEA Public Schools in Texas.

For the 2021–22 academic year, the district chose 30 schools to offer an AP Computer Science course. AIR randomly assigned half of these schools to receive the BJC curriculum (intervention condition) and half to the comparison condition. Comparison schools used the Code.org curriculum, which is the default curriculum at IDEA Public Schools; almost all schools that taught AP-CSP were already using that curriculum, some for multiple years.

The randomization design consisted of two components: (a) school-level randomization blocks and (b) constrained randomization (i.e., rerandomization) to balance continuous covariates.

### Study Participants

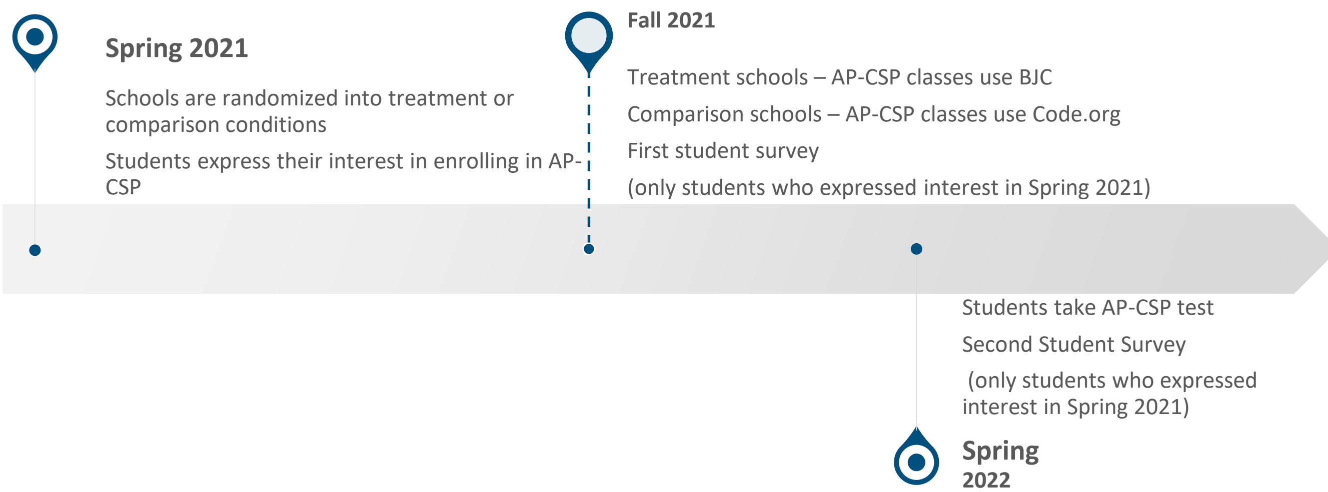
**Target student population.** The study's target population was students who had requested to take the AP-CSP course in the spring before randomization (i.e., spring 2021). Students who joined clusters after random assignment (called "joiners" in What Works Clearinghouse [WWC] standards) could pose a potential risk of bias because it is possible that students in the treatment school could have been induced to take CS upon learning about the new course offering, in which case the sample of students in the treatment schools could be systematically different from the sample of students in the comparison schools. To avoid this risk, students were excluded from the impact evaluation if they had not made a course request in the previous spring, even if they enrolled into the course later (e.g., in the fall after randomizing schools).

Randomization of schools was conducted in spring 2021 after student rosters were established. No active student consent was required by the district so all students on the spring rosters formed the analysis sample. Students were offered opt-out consent at the time of taking the student survey. All students on the rosters were included in the analyses, regardless of whether they moved to a school in a different condition. No new students were added to the sample after randomization of schools.

**Grade level.** Students spanned Grades 9–12. The district recommended offering the course to any student in Grades 9–12, but each campus ultimately had the discretion to decide at what grade levels they offered the AP-CSP course. Though the analytic sample included students from multiple grade levels, the baseline for all students was the score on the mathematics achievement test in Grade 8 (i.e., creating a baseline-outcome lag of 1 year for ninth graders

who take AP-CSP but 3 years for 11th graders). We focused on baseline Grade 8 mathematics test scores because the district's data for standardized mathematics test scores in high school are more limited.

**Figure 1. Randomization and Implementation Timeline**




## Randomization

**Randomization blocks for randomization.** For randomizing schools, we formed three randomization blocks based on a school's prior history of offering and improving its AP-CSP courses. These blocks separated (a) four curriculum super-users, or schools heavily involved in improving their AP-CSP courses; (b) 14 schools with some prior history of offering AP-CSP but that were not super-users; and (c) 12 schools with no history of offering AP-CSP prior to the 2021–22 year (some of which had some prior computer science course offerings, but not AP-CSP).

Within each block, the same number of schools were assigned to each condition (blocks may have differed by one school if an odd number of schools were in the block). For blocks with an odd number of schools, having one additional intervention school (e.g., four in the intervention group and three in the comparison group) was equally as likely as having one additional comparison school (e.g., three in intervention and four in comparison). Hence, an individual school's probability of receiving the intervention was always 50%. We required an equal total number of intervention and comparison schools summed across all blocks. We created blocks based on prior experience because, theoretically, we suspected that a school's prior history of offering AP-CSP could be highly correlated with student outcomes. In order to guard against any chance that a systematic difference between the treatment and comparison groups in this

dimension would lead to bias in our results, we grouped schools based on their prior experience and randomized within group to ensure more equal comparisons.

**Constrained randomization to balance continuous covariates for randomization.** We implemented procedures described by Morgan and Rubin (2012) to further constrain the set of possible randomizations and achieve optimal balance for two key continuous covariates: (a) prior mathematics standardized achievement and (b) prior overall grade point average (GPA). Based on the district's historical data, these two covariates emerged as the strongest predictors of our key outcome (i.e., AP-CSP scores). Hence, achieving optimal balance on these predictors (i.e., minimizing baseline differences) increased statistical precision of the study's treatment effect estimate (Morgan & Rubin, 2012, 2015).[4]

We used the Mahalanobis distance metric as an indicator of global covariate balance (smaller values indicate better balance), following Morgan and Rubin's (2012) recommendations. We computed these distances for the full set of 26 schools, collapsing across randomization blocks (e.g., imbalance in one block could offset an opposite-direction imbalance in another block).[5]

## Impact Evaluation Model

The main impact model was a two-level mixed-effects model to estimate treatment-control differences for continuous AP-CSP scores, controlling for baseline covariates and fixed effects of randomization blocks, including between-school and within-school error terms.

The AP-CSP score $Y_{ij}$ for student *i* in school *j* was modeled as follows:

$$Y_{ij} = \gamma_{00} + \gamma_{01}T_j + \boldsymbol{\gamma_{02}}'\boldsymbol{B_j} + \boldsymbol{\gamma_{03}}'\boldsymbol{X_{ij}} + \mu_{0j} + \varepsilon_{ij} \quad (1)$$

Where,

$Y_{ij}$ = outcome score for student *i* in school *j*

[4] We also considered balancing on a school-level measure of economic disadvantage (e.g., percentage of students eligible for free or reduced-priced lunch), but it was a lower priority because of its weaker historical correlation with the focal outcome. Other covariates included the dummy codes for the grade level at which a school offers AP Computer Science (e.g., some schools might offer it at ninth grade, but others could offer it at 10th grade). We also gave these grade-level dummy codes lower priority because grade level has not been a strong predictor of scores in the district's historical data (e.g., 12th graders have scored about the same as ninth graders on the AP exam, despite being 3 years older). We used the "tiers of importance" procedures described by Morgan and Rubin (2015) to incorporate these other supplemental covariates in the randomization design, while giving them less weight than more prognostic covariates (i.e., using less stringent cutoffs for defining acceptable randomizations).

[5] The set of possible randomizations were defined based on a Mahalanobis distance cutoff (e.g., smallest 1 in 100) prior to randomly choosing one specific randomization for the study. We set the cutoff value to allow for at least 1,000 possible randomizations. Morgan and Rubin (2012) called this procedure *rerandomization*, suggesting a sequential process of discarding attempts until an acceptable randomization is found. We prefer, however, to consider this process *constrained randomization*, which is mathematically equivalent. For instance, blocked randomization is one type of randomization constraint, and choosing small Mahalanobis distances imposes another constraint to achieve optimal balance on continuous covariates.

$\gamma_{00}$ = average covariate-adjusted outcome for control students

$\gamma_{01}$ = covariate-adjusted treatment-control difference

$T_j$ = dummy indicator for treatment assignment for school *j* (1 = treatment; 0 = control)

$\boldsymbol{\gamma_{02}}$ = vector of regression coefficients for effects of randomization blocks

$\boldsymbol{B_j}$ = vector of dummy codes for randomization block membership for school *j*

$\boldsymbol{\gamma_{03}}$ = vector of regression coefficients for effects of baseline covariates

$\boldsymbol{X_{ij}}$ = vector of baseline covariate values for student *i* in school *j* (eighth-grade attendance rate, overall GPA, math GPA, standardized test score, grade level in 2021, and school-level AP-CSP achievement level)

$\mu_{0j}$ = error term for school *j*

$\varepsilon_{ij}$ = error term for student *i* in school *j*

The main term of interest is $\gamma_{01}$ for the estimated treatment-control difference in outcome means, after controlling for school-level randomization blocks and baseline covariates while accounting for the nesting of students within schools. This model was to accommodate the other outcomes (e.g., including using multilevel logistic regression models for any dichotomous outcomes).

## Handling Missing Data

**Missing outcome data.** Our confirmatory models did not analyze students with missing outcome data. However, as supplemental sensitivity analyses, we used multiple imputation procedures to impute missing outcome values for analyses of continuous scores. We analyzed five imputed data sets and pooled their results. Imputation models encompassed all included baseline covariates, a treatment assignment indicator variable, and the outcome, consistent with WWC's (2022) *Procedures and Standards Handbook, Version 5.0* for applying multiple imputation procedures. Imputation of outcome data is not needed for analyses of dichotomized AP-CSP scores, as noted earlier.

**Missing baseline data.** We used multiple imputation procedures to impute missing baseline data, following the same specifications as noted above (e.g., including the outcome in the imputation model). As sensitivity analyses, we also conducted complete case analyses for the subset of students with observed baseline data and observed outcome data.

## Outcome Measures

The two main outcome measures of interest were students' AP-CSP test scores and enrollment in AP-CSP. Student test scores were then used to construct an indicator for whether a student

passed the AP-CSP test. Because there were no premeasures of this outcome (AP-CSP test score), to establish baseline equivalence we utilized eighth-grade standardized math test scores as a premeasure of student academic ability, GPA, English proficiency, economic disadvantaged status, gender, and ethnicity.

The primary effect size was the unstandardized mean differences in AP-CSP test scores because the 1–5 outcome scale is immediately interpretable to practitioners, more so than standardized mean differences. These unstandardized mean differences came from regression models that control for baseline covariates but do not standardize the outcome variable.

However, we also compute standardized effect sizes as supplemental metrics for the AP-CSP mean score differences (or other outcomes, such as student attitudes). We use the procedures outlined in the supplement to the WWC (2020) *Procedures Handbook, Version 4.1* to compute effect sizes for cluster designs, using the total variability (both between and within clusters) as the standardizer. More specifically, we divide the unstandardized mean difference by the within-intervention group pooled standard deviation, then apply relevant bias-correction terms to compute the Hedges' *g* values.

We collected data on students' test scores, GPA, and demographic characteristics directly from IDEA Public Schools in spring 2021 and data on students' AP-CSP test scores in spring 2022.[6]

We were also interested in understanding the effects of the BJC curriculum on students' behavioral outcomes, interest in computer science, and intention to study computer science in college. To that end, the research team conducted a survey in fall 2021 (September) and spring 2022 (May) to measure these outcomes. The survey was made up of 7 constructs: behavioral, cognitive, emotional, social, confidence, interest, and college intentions. All items on each construct were measured on a scale of 1 to 4. Details on the student survey are presented in Appendix B.

## The Sample

As mentioned in previous sections, the randomized sample consisted of 15 treatment group schools, and 15 comparison group schools. Because we relied on administrative records to examine the achievement outcomes (test scores and passing rate), we expected that we would have no attrition at the school level. However, one of the schools in our sample was dropped because its student test scores were lost in the mail and therefore were not available (treatment condition), and another school dropped out of the study (comparison condition).

[6] Although schools were no longer participating in an RCT in fall 2022 and spring 2023, we obtained AP-CSP course taking and test scores for the 2022–2023 academic year from IDEA Public Schools to provide some descriptive information on students' enrollment and achievement in AP-CSP.

Exhibit 2 describes the randomized and analytic sample sizes and provides a determination for whether overall attrition is considered high or low based on WWC standards Version 5.0. In Exhibit 2, "clusters" refers to schools. First, we estimated the overall cluster-level attrition, which was 6.7% for the achievement outcomes and 60.0% for the survey outcomes, and the differential attrition (the difference in attrition rates between the treatment and comparison groups) was 0% for both types of outcomes. Next, we examined the overall student-level attrition, which was 50.2% for the achievement outcomes and 84.8% for the survey outcomes. The differential student-level attrition was 12.9% for the achievement outcomes and 3.8% for the survey outcomes.

For the achievement outcomes, although the cluster-level attrition is low by both the cautious and optimistic boundary, the student-level attrition is high according to both boundaries. For the survey outcomes, the cluster-level attrition is considered low based on the optimistic boundary, but the student-level attrition is also high according to both boundaries.

### Exhibit 2. Sample Sizes at Randomization and in Analytic Sample for Student Outcomes

| Outcome measure | Treatment group | | | | Comparison group | | | | Attrition[1] |
|---|---|---|---|---|---|---|---|---|---|
| | Clusters | | Students | | Clusters | | Students | | |
| | # random-ized | # analytic sample | # random-ized | # analytic sample | # random-ized | # analytic sample | # random-ized | # analytic sample | |
| Test score | 15 | 14 | 856 | 480 | 15 | 14 | 818 | 353 | High |
| Pass rate | 15 | 14 | 856 | 480 | 15 | 14 | 818 | 353 | High |
| Behavioral | 15 | 6 | 856 | 114 | 15 | 6 | 818 | 140 | High |
| Cognitive | 15 | 6 | 856 | 114 | 15 | 6 | 818 | 140 | High |
| Emotional | 15 | 6 | 856 | 114 | 15 | 6 | 818 | 140 | High |
| Social | 15 | 6 | 856 | 114 | 15 | 6 | 818 | 140 | High |
| Confidence | 15 | 6 | 856 | 113 | 15 | 6 | 818 | 138 | High |
| Interest | 15 | 6 | 856 | 113 | 15 | 6 | 818 | 138 | High |
| College intentions | 15 | 6 | 856 | 113 | 15 | 6 | 818 | 138 | High |

*Source*. AIR's analysis based on data provided by IDEA Public Schools.

[1] Attrition is considered high by both the cautious and optimistic boundaries.

# Impact Findings

## Baseline Equivalence

We assessed baseline equivalence on student background characteristics and measures of academic achievement at the individual student level. To do so, we estimated a statistical model similar to the main impact model, with the baseline measure as a dependent variable and the treatment indicator as an independent variable. Next, we divided the regression coefficient by the pooled sample standard deviation for each measure to obtain the standardized difference listed in Exhibit 3. The differences between the treatment and comparison group indicate that the two groups were equivalent at baseline on all but one covariate: The treatment group had a higher attendance rate than the comparison group. The standardized differences between the two groups were less than 0.25 standard deviation on all other covariates.

### Exhibit 3. Results From Baseline Equivalence Assessment for the Analytic Sample

| Measure | Treatment group | | | Comparison group | | | Standardized difference |
|---|---|---|---|---|---|---|---|
| | Sample size | Mean | Standard deviation | Sample size | Mean | Standard deviation | |
| 8th-rade math test score (standardized) | 462 | 0.38 | 1.00 | 334 | 0.06 | 0.98 | 0.17 |
| 7th-grade math test score | 413 | 1,758 | 140 | 285 | 1,740 | 144 | 0.13 |
| Overall GPA (out of 100) | 480 | 87.21 | 8.21 | 353 | 86.99 | 7.49 | 0.03 |
| Math GPA (out of 100) | 480 | 86.32 | 9.53 | 353 | 84.94 | 9.08 | 0.15 |
| Grade level | 480 | 9.43 | 0.89 | 353 | 9.33 | 1.25 | 0.09 |
| Attendance rate | 461 | 99% | 1% | 332 | 98% | 2% | 0.38 |
| Limited English proficiency | 480 | 31.46% | _ | 353 | 41.64% | _ | –0.27 |
| Free or reduced-price lunch | 480 | 48.75% | _ | 353 | 56.09% | _ | –0.18 |
| Special education | 480 | 3.13% | _ | 353 | 3.40% | _ | –0.05 |
| Hispanic | 480 | 93.13% | _ | 353 | 91.78% | _ | 0.12 |
| Male | 480 | 52.71% | _ | 353 | 52.97% | _ | –0.01 |

*Note*. Means and differences are unadjusted. The standardized difference was computed by dividing the difference by the pooled standard deviation of the two groups (Hedges' *g*). GPA = grade point average. Since the passing rate and score outcomes are derived from the same variable as the AP-CSP test score, the analytic samples are the same. Therefore, these baseline equivalence estimates are for all three AP-CSP performance outcomes. Baseline equivalence calculations do not include any imputed values.
*Source*. AIR's analysis based on data provided by IDEA Public Schools.

## Impact Results – Student Performance on the AP-CSP Test

To measure the impacts of teaching the BJC curriculum on schools that were assigned to the treatment condition compared to schools that were assigned to the comparison condition, we estimated a two-level mixed-effects model controlling for baseline covariates and fixed effects of randomization blocks, as described in equation (1) earlier. The outcomes we examine using the impact analysis model include AP-CSP test score and achieving a passing score. We also use the impact model to estimate the effects of BJC on student attitudes, only using data from the fall 2021 and spring 2022 surveys.

Our findings from the RCT indicate that the BJC curriculum did not have any statistically significant impacts on student test scores, engagement, confidence and interest, or intentions to pursue CS further in college or career. Although not statistically significant, the results display estimates in the negative direction for both test scores and passing rates. As for the survey outcomes, students in the treatment condition responded less favorably on all but the emotional and social survey constructs.

This suggests that using the BJC curriculum in AP-CSP classes did not have an impact on students. Descriptively, the pattern of the results shows that students who attended schools that used the BJC curriculum scored lower and exhibited fewer positive attitudes toward AP-CSP. It is important to emphasize, however, that these results are not statistically significant, so we cannot say with confidence that these patterns emerged as a result of implementing the BJC curriculum in AP-CSP classrooms, nor that they were statistically different from the comparison condition. We discuss possible reasons why the BJC curriculum was not effective later in the Qualitative Data Collection and Analysis section.

### Exhibit 4. Impact Analysis Results—Complete Case Analysis Only

| Outcome measure | Treatment group | | | | Comparison group | | | | Treatment-control difference | Standard error | Standardized difference | *p*-value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample size | | Mean | Standard deviation | Sample size | | Model-adjusted. mean | Standard deviation | | | | |
| | # clusters | # students | | | # clusters | # students | | | | | | |
| Test score | 14 | 480 | 1.82 | 0.94 | 14 | 353 | 2.05 | 0.96 | –0.23 | 0.250 | –0.24 | .376 |
| Passing score | 14 | 480 | 0.14 | NA | 14 | 353 | 0.13 | NA | 0.14 | 0.961 | 0.05 | .888 |
| Pass rate | 14 | 480 | 0.22 | NA | 14 | 353 | 0.36 | NA | –1.24 | 0.817 | –0.43 | .129 |
| Behavioral | 14 | 114 | 1.85 | 1.72 | 14 | 140 | 2.25 | 1.94 | –0.40 | 0.675 | –0.21 | .685 |
| Cognitive | 14 | 114 | 1.65 | 1.62 | 14 | 140 | 2.02 | 1.92 | –0.36 | 0.746 | –0.20 | .681 |

| Outcome measure | Treatment group: Sample size: # clusters | Treatment group: Sample size: # students | Treatment group: Mean | Treatment group: Standard deviation | Comparison group: Sample size: # clusters | Comparison group: Sample size: # students | Comparison group: Model-adjusted. mean | Comparison group: Standard deviation | Treatment-control difference | Standard error | Standardized difference | *p*-value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Emotional | 14 | 114 | 2.69 | 2.13 | 14 | 140 | 2.28 | 2.32 | 0.42 | 0.969 | 0.18 | .735 |
| Social | 14 | 114 | 2.09 | 1.69 | 14 | 140 | 2.06 | 1.95 | 0.03 | 0.787 | 0.02 | .975 |
| Confidence | 14 | 113 | 4.13 | 5.07 | 14 | 138 | 5.89 | 6.05 | –1.76 | 3.229 | –0.30 | .672 |
| Interest | 14 | 113 | 2.40 | 3.87 | 14 | 138 | 4.37 | 4.34 | –1.97 | 2.886 | –0.47 | .572 |
| College intentions | 14 | 113 | 1.12 | 2.73 | 14 | 138 | 1.17 | 2.64 | –0.05 | 0.601 | –0.02 | .932 |

### Exhibit 5. Impact Analysis Results—Multiple Imputation

| Outcome measure | Treatment group: Sample size: # clusters | Treatment group: Sample size: # students | Treatment group: Mean | Treatment group: Standard deviation | Comparison group: Sample size: # clusters | Comparison group: Sample size: # students | Comparison group: Model-adjusted mean | Comparison group: Standard deviation | Treatment-control difference | Standard error | Standardized difference | *p*-value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Test score | 14 | 480 | 1.89 | 0.94 | 14 | 353 | 1.86 | 0.96 | 0.03 | 0.183 | 0.03 | .880 |
| Passing score | 14 | 480 | 0.141 | NA | 14 | 353 | 0.10 | NA | 0.54 | 0.680 | 0.21 | .430 |
| Pass rate | 14 | 480 | 0.240 | NA | 14 | 353 | 0.26 | NA | -0.19 | 0.669 | –0.06 | .776 |
| Behavioral | 14 | 114 | 1.54 | 1.72 | 14 | 140 | 1.48 | 1.94 | 0.06 | 0.340 | 0.03 | .855 |
| Cognitive | 14 | 114 | 1.26 | 1.62 | 14 | 140 | 1.23 | 1.92 | 0.03 | 0.340 | 0.01 | .941 |
| Emotional | 14 | 114 | 1.75 | 2.13 | 14 | 140 | 1.28 | 2.32 | 0.48 | 0.522 | 0.21 | .426 |
| Social | 14 | 114 | 1.45 | 1.68 | 14 | 140 | 1.27 | 1.95 | 0.18 | 0.303 | 0.10 | .544 |
| Confidence | 14 | 113 | 4.77 | 5.07 | 14 | 138 | 3.96 | 6.05 | 0.80 | 1.453 | 0.14 | .603 |
| Interest | 14 | 113 | 3.14 | 3.87 | 14 | 138 | 3.38 | 4.34 | -0.23 | 0.873 | –0.06 | .801 |
| College intentions | 14 | 113 | 1.27 | 2.73 | 14 | 138 | 0.94 | 2.64 | 0.32 | 0.598 | 0.12 | .597 |

*Note*. The treatment group means are unadjusted means; the control group means were computed based on the unadjusted treatment group means and the estimated mean differences. Effect sizes were computed as Hedges' *g* for continuous outcomes and Cox's index for dichotomous outcomes.

**Exhibit 6. Additional Information for Test Score Outcome and Baseline Measure with Imputed or Missing Data in the Analytic Sample**

| Sample[7] | Treatment group | | | Comparison group | | |
|---|---|---|---|---|---|---|
| | # individuals | Mean of baseline measure[8] | Mean of outcome measure | # individuals | Mean of baseline measure | Mean of outcome measure |
| Analytic sample (same as Exhibit 6 or 7) | 480 | 0.37 | 1.95 | 353 | 0.07 | 1.78 |
| Subsample of individuals with nonmissing values for outcome and baseline measures | 462 | 0.38 | 1.94 | 334 | 0.06 | 1.78 |
| Subsample of individuals with nonmissing outcome measure and missing baseline measure | 18 | NA | 2.06 | 19 | NA | 1.79 |
| Subsample of individuals with nonmissing baseline measures and missing outcome measures | 425 | 0.09 | NA | 329 | -0.08 | NA |
| Correlation between the baseline and outcome measures (calculated using only nonimputed data): 0.512 | | | | | | |

## Limitations of the Impact Analysis

This study was designed as a randomized controlled trial, which is the gold standard of impact studies. However, when attrition rates are high, the analytic sample is no longer representative of the randomized sample. Baseline equivalence ensures that the results are not biased due to the effects of unobserved student characteristics, but the results cannot be generalized to the overall sample that was initially randomized. In this study, one school's student test scores were lost in the mail; therefore, that entire school's student sample was not included in the study, including both the impact analysis on test scores and survey responses. Additionally, teachers who were assigned to the treatment condition reported that they still used some of the Code.org resources, which means the randomization may have been contaminated. More details on this are provided in the Qualitative Data Collection and Analysis section. Survey completion was also a major challenge given that the overall response rate was only around 15%.[9]

[7] The test score was used to construct the passing score and passing rate outcomes. Therefore, the sample sizes for those two outcomes are the same as the sample sizes presented in this table.
[8] The baseline measure reported in this table is standardized grade 8 math test score.
[9] This response rate differs from the rates presented in Exhibit 8 because it only includes students for whom student IDs were collected during the survey so that they could be matched to their administrative record. Unfortunately, many students' IDs were not collected during the survey, so we do not include them in the impact analysis, however, they are included in the descriptive survey results.

## Survey

### Student Survey Data Collection and Analysis

AP-CSP students completed surveys administered by AIR during fall 2021 and 2022 and spring 2022, 2023, and 2024. AIR analyzed their responses to answer the research question: How do students, teachers, and leadership experience the curriculum implementation? Code.org was no longer the official IDEA Public Schools curriculum in 2024.

The student survey collected information on the following areas: engagement (including cognitive, behavioral, emotional, and social), confidence, interest, and postsecondary and computer science as a career. For each area, multiple items measured different aspects, so one scale score could be created that took all of these aspects into account (see Appendix B for student survey items). The scale score was created using the Rasch model. For one question, regarding plans to take a computer science class next year, a scale score could not be created because there was only one item, so frequencies were calculated and reported.

Exhibit 7 shows the student survey response rates for each administration.

**Exhibit 7. Student Response Rates**

| Time | Student survey response rate |
|---|---|
| **Computer science principles** | |
| Fall 2021 | **43%** (659/1,549) |
| Spring 2022 | **24%** (416/1,736) |
| Fall 2022 | **46%** (800/1,736) |
| Spring 2023 | **34%** (644/1,890) |
| Spring 2024 | **38%** (1,139/3,004) |

From the first year of administration to the end, eight parents opted their students out of participating in the survey and an average of 2% of students opted themselves out.

### *Student Survey Findings*

In every survey administration period (fall 2021–spring 2024), most students reported that they were engaged and had confidence and interest in AP-CSP. Many students agreed that they would pursue computer science courses in postsecondary education and were positive toward computer science as a career.

There were a few differences between students in treatment and comparison schools and between years. Fall 2021 was the first data collection and determined whether there were differences between students in treatment and comparison schools. Students had not been exposed to the BJC curriculum yet. No differences were observed in 2021. During the next administration, in spring 2022, after the first-year students had been exposed to the BJC curriculum, treatment students reported higher cognitive engagement. During the fall 2022 administration, treatment students still reported higher cognitive engagement. No differences were observed for the spring 2023 administration. In the last administration, in spring 2024, comparison students reported significantly higher behavioral, emotional, and social engagement and reported higher interest and postsecondary intentions. These findings were statistically significant.

Regarding change between years, all students reported a significant decrease in cognitive engagement between fall 2021 and spring 2022. Between spring 2022 and spring 2023, all students reported a decrease in interest. Between spring 2023 and spring 2024, there was a decrease in all areas (engagement [including cognitive, behavioral, emotional, and social], confidence, interest, and postsecondary and computer science as a career). These findings were statistically significant.

When students were asked, “Do you plan to take any AP-CSP classes next year that are not required (elective AP-CSP courses),” in most years less than half of students said no to this question, although in spring 2022 more than half (52%) said no. In each administration, there were differences between grade levels when responding to this question. For example, in 2024, more than half (56%) of students in 12th grade said no to this question, whereas 28% of students in ninth grade said no (see Appendix F for responses to this question).

## Teacher Survey Data Collection and Analysis

Teachers completed surveys administered by AIR during fall 2022 and spring 2022, 2023, and 2024. AIR analyzed their responses to answer the research question: How do students, teachers, and leadership experience the curriculum implementation? Surveys were administered to AP-CSP teachers teaching the redesigned curriculum. Code.org was no longer the official IDEA Public Schools curriculum in 2024.

The teacher survey items focused on teachers’ perception and use of the redesigned curriculum, instructional practices, and how prepared they felt to teach AP-CSP. AIR averaged teachers’ responses for each item to answer the research question.

Exhibit 8 shows the teacher survey response rates for each administration.

**Exhibit 8. Teacher Response Rates**

| Time | Teacher survey response rates |
|---|---|
| **Mathematics** | |
| *(Pilot in spring 2020)* | |
| Spring 2022 | **34%** (12/35) |
| Fall 2022 | **26%** (9/35) |
| Spring 2023 | **27%** (9/34) |
| Spring 2024 | **25%** (13/51) |

### *Teacher Survey Findings*

For the first four survey administrations, approximately half (40%–50%) of teachers reported using Code.org and a little more than half (54%–60%) reported using BJC, so there was some representation for each curriculum. During the final year, IDEA schools discontinued use of Code.org, so almost all teachers reported using BJC during that year.

The survey asked teachers questions about their use of the curriculum (the extent to which it was their primary curriculum), their perceptions of the curriculum, their preparedness to teach CSP, how often they used CSP classroom instruction best practices, and CSP teaching efficacy, beliefs, and support.

**Curriculum use.** Except for fall 2022, teachers reported teaching primarily with their school's adopted materials along with a few other supplementary materials. In fall 2022 teachers reported teaching only using their school's adopted materials.

**Curriculum perceptions.** In two of the years, spring 2022 and 2024, teachers reported that the BJC curriculum was harder to use than Code.org for CSP. In fall 2022 teachers reported the two curricula were the same in terms of ease of use, and in spring 2023 teachers reported that BJC was easier, about the same, or harder than Code.org in equal percentages. For teachers who had used a CSP curriculum other than Code.org or BJC, most reported that their school's adopted materials, either Code.org or BJC, were about the same or harder to use than other CSP curricula. For teachers who had used other non-CSP course curricula, teachers reported mixed results, with most reporting that their school's adopted CSP materials were either easier, about the same, or harder to use than non-CSP curricula at about the same rate.

**Preparedness to teach CSP.** Overall, in all years, an average of 47% of teachers reported that they felt very well prepared to use the suggested CSP instructional practices. When asked in general how prepared they felt to teach CSP, an all-years average of 53% reported that they feel very prepared.

**Classroom instruction practices.** When asked about recommended CSP classroom instructional practices, an all-years average of 43% of teachers reported that they used these practices in all or almost lessons and 5% said they never use them.

**Teaching efficacy, beliefs, and support.** An all-years average of about 90% of teachers agreed or strongly agreed with statements about their efficacy and beliefs about CSP. When asked if they received professional development or other supports for CSP curriculum that year to help their instruction, 100% of teachers in fall 2021 said yes and 79% of teachers in spring 2024 said yes.

**Conclusion.** Overall, teachers reported that they taught primarily with their school's adopted materials along with a few other supplementary materials. They also reported that they found the BJC curriculum more difficult to use than Code.org. Teachers said they felt well prepared to teach AP-CSP and expressed self-efficacy in teaching AP-CSP. Their responses also demonstrated that they implemented recommended AP-CSP instructional strategies and engaged students in CSP instruction (see Appendix E for response option percentages).

### Limitations

The survey results are descriptive only. Comparing groups should be done with caution because of small differences between groups. Not all schools participated in the survey, which could impact the validity of findings. Some responses were incomplete and so could not be included in the analysis.

## Qualitative Data Collection and Analysis

### Overview of Qualitative Data Collection

To supplement the quantitative findings, AIR conducted interviews and focus groups with members of the IDEA headquarters staff, school leaders, and teachers from both the treatment and control groups of the study. The data from interviews provided deeper understanding and insights on how teachers, leadership, and students experienced implementation of both CSP curricula. The interviews and focus groups allowed for more detailed responses than a fixed-response survey and enabled AIR to probe stakeholder perceptions of implementation and curriculum effectiveness. In particular, the interview and focus group data contributed to a richer understanding of challenges experienced during implementation, the resources and supports needed to ensure successful implementation, and the experiences of teachers, school leaders, and students involved in curriculum implementation.

In the 2021–22 school year, all math and computer science teachers and headquarters staff were recruited to participate. Teachers and headquarters staff could opt to participate, signing up directly with AIR, selecting the date/time that worked best for their schedules. In April and May 2022, 17 focus groups were conducted, comprising 21 individuals. Eight of those participants were headquarters staff and six were computer science teachers from either the control or treatment condition.

In the 2022–23 school year, math and computer science teachers were randomly selected to participate in focus groups and invited to sign up for participation through an email invitation. If teachers elected not to participate, additional groups of math and computer science teachers were recruited. At the end of the recruitment cycle, the sample was exhausted, and all math and computer science teachers were invited to participate. In March and April 2023, 16 interviews and focus groups were conducted, comprising 22 individuals. Four of those participants were curriculum managers and five were computer science teachers from either the control or treatment condition.

## Findings From Interviews and Focus Groups

### *General Feedback on Implementation*

According to headquarter staff and curriculum managers in the interviews and focus groups, the goal of the computer science curriculum implementation has been to bring a larger number of students into the AP Computer Science Principles exams to have the potential to earn college credits in computer science. Additionally, staff emphasized the goal of building students' thinking and problem-solving skills through computer science approaches within the curriculum.

Through the structure of the randomized controlled trial, teachers were randomly assigned to teach one of two curricula. Some teachers continued using the Code.org computer science curricula, whereas others transitioned to using the new curriculum, Beauty and Joy of Computing.

Overall, the curriculum manager and headquarters staff reported that implementation of the computer science curriculum has gone well, despite encountering some challenges for those transitioning to the new BJC curriculum.

### *Benefits of Curriculum Implementation*

**Access and exposure to computer science.** Teachers agreed that both the Code.org and BJC curricula give students exposure and access to computer science. Teachers also appreciated that both curricula are free to use and easy to access. Teachers noted that Code.org content can be accessed from a computer or mobile device, with the flexibility to download or print course materials. One computer science teacher shared that though the BJC curriculum can be

challenging for students at the start, with enough support and guidance from teachers on interpreting and applying the content, students are able to build strong coding skills.

Headquarters staff and the curriculum manager reported that there is hope to expand computer science in K–12 and a desire for computer science to be integrated at all grade levels, creating a pathway into computer science as a field for students. This opportunity could provide access and exposure to students, continuing to cultivate interest in the fields of computer science and STEM. Teachers and staff acknowledged the benefits from providing access and exposure to students, including expanding opportunities for future career and postsecondary education pathways.

**Minimal experience required.** Teachers also shared that they appreciated the approachability of both curricula, which seem to allow teachers with any range of experience in computer science to teach the course, even if they are new to the field. Teachers shared that the Code.org curriculum, in particular, has helped teachers without a strong content background to be comfortable enough to teach computer science.

**Preference for Code.org**. Overall, teachers using Code.org seemed to be more satisfied with the curriculum, content, and support provided. Teachers using Code.org noted detailed guidance offered in lesson planning and resources/materials. As described by one teacher, "Code.org has lesson plan involvements from [beginning] to the end. Everything is detailed and Code.org has a lot of resources to use in the classroom."

### *Challenges in Curriculum Implementation*

Although headquarter staff and teachers noted that they appreciated the goals in implementing computer science curricula, many described challenges in initially implementing the BJC curriculum. Some of the challenges discussed below pertain specifically to those teachers assigned to the BJC curriculum. However, over time the severity of these challenges has seemed to diminish, as curriculum managers have been able to address feedback from teachers and fill in gaps of former concern.

**Limited content.** According to teachers, the BJC materials would often cover only a portion of the class time and require teachers to fill the remaining class time with additional content for which they would be responsible. This required teachers to figure out ways to supplement the BJC curriculum, as advised by their curriculum manager. Based on feedback from teachers, BJC has been more of a "supplemental tool, rather than a leading curriculum," as it required teachers to pull other materials to teach. Teachers included content learned from other sources, such as YouTube, Khan Academy, and Code.org. Teachers remarked that BJC touched on concepts only briefly without going into the depth they felt they needed. Practice questions and teacher guides were not provided for BJC. One teacher noted that it also does not provide progress checks or

teacher class management guides. In comparison, Code.org had a formal structure that filled class time appropriately. Teachers noted that the Code.org curriculum was user-friendly and included a lesson plan and an exit ticket. Although many teachers were initially displeased with the BJC curriculum when first assigned, some teachers expressed contentment with the BJC materials during focus groups conducted in 2023. However, these teachers shared that it has still been necessary to continue supplementing the BJC materials with other external materials.

**Limited support.** In addition to needing to supplement the BJC curriculum with additional course materials, teachers who were assigned to implement BJC initially expressed desire for more supports with instruction and implementation. Teachers shared the need for support in the form of training or guidance on implementing the BJC curriculum given its limited content. Though there were initially challenges in the first year in determining the right types of supports for teachers, there was improvement in supports for teachers during the 2022–23 school year, with the curriculum manager providing supplemental materials (e.g., exit tickets) for teachers to use with the BJC curriculum. As described by one math teacher, “Our curriculum manager went . . . 10 steps ahead of us and actually . . . stepped out [and provided] PDFs for us to use, . . . for exit tickets to, you know, test questions that had . . . block images along with . . . the coding on paper.”

**Limited teacher experience.** According to the computer science curriculum manager, teachers with limited computer science and programming background may have a more difficult time implementing the computer science curriculum. The curriculum manager observed that teachers who had difficulty understanding the materials (or lacked the background content knowledge) struggled in teaching and adjusting the curriculum for their students. One computer science teacher described initially learning the material alongside the students in their first year with the curriculum. The curriculum manager and computer science teachers noticed improvements after just 1 year of implementing BJC. However, the curriculum manager noted the CS curriculum implementation would benefit if the CS teachers had more content knowledge and a computer science background.

> *Last year was a little different because I was actually learning along with the kids since I was—it was my first year teaching computer science ever. This year, my role, I feel a lot more comfortable with the curriculum because of the coding that they give us. I had to actually learn like each block and I feel like I've done a better job over the summer learning that. So I did do a lot of things on my own. And last year I would say that I ended up writing out stuff a lot more for the kids because I didn't have resources.* —CS teacher

**Issues with technology.** Some teachers encountered technological challenges when implementing both computer science curricula. One of the most common challenges was managing issues of student access to computers. Because the curriculum relies heavily on using

computers, teachers expressed frustration with delays in gaining access to enough computers for their classes. One teacher reported that in the first week of school, students did not have computers yet, which required the teacher to adjust instruction. Teachers also remarked on the challenge of students maintaining their work, especially with students regularly forgetting their passwords or forgetting to save their work on projects. Teachers using BJC expressed additional frustration in using the BJC website to access course materials and running into bugs in the system while trying to access materials.

## Professional Opportunities, Support, and Feedback

Teachers and headquarters staff were asked to describe the supports and opportunities teachers were provided throughout the implementation of both the Code.org and BJC computer science curricula. These supports and opportunities included professional development opportunities, trainings, meetings, and resources provided to teachers to support their implementation of the computer science curricula to which they were assigned.

**New Teacher Institute.** At the beginning of each school year, new teachers were offered a training session to introduce the curriculum, walk through the units, and discuss general implementation strategies. The training for teachers, as well as school leaders, has been geared toward strategies and pedagogical practices that are applicable across content areas. Teachers appreciated the training, which served as an introduction. However, they remarked that they would appreciate more support throughout the school year.

**Biweekly webinars.** Biweekly webinars were offered by curriculum managers for additional sharing of best practices and lesson planning. During the webinars, the curriculum manager reviewed the upcoming 2 weeks of lessons for the unit, providing resources and tips on delivering the content and offering a space for Q&A. Headquarters staff remarked that the sessions provided an opportunity to discuss potential challenges and unpack upcoming lessons. Although teachers appreciated having webinars to meet with the curriculum managers, they did not always find the sessions helpful in terms of how to teach the content.

**Direct support from curriculum managers.** In addition to more structured opportunities for teachers, curriculum managers provided direct “on the ground” support in facilitating curriculum implementation. Because curriculum managers were involved in the development of and ongoing revisions to the curriculum, they have made themselves available to support teachers in implementing the lessons they created. Teachers using Code.org appreciated the guidance and support provided by the curriculum manager, particularly in setting specific objectives.

> *Our curriculum manager has done an excellent job in terms of setting everything up day by day. He does have main ideas and specific objectives.* —CS teacher

**Teacher collaboration.** Teachers, particularly those teaching BJC, relied on one another for support and sharing of materials. Teachers also relied on YouTube and other videos for help with understanding concepts before teaching them. Though teachers found that getting together to help each other on curriculum supplementation and implementation has been helpful, there was a divide that happened with the two different curricula.

## Recommendations for Improvement

Throughout focus groups and interviews, teachers and headquarters staff offered recommendations and opportunities for improvement across the curriculum implementation process. Curriculum managers noted that curriculum development and implementation is an ongoing process.

**Accessibility.** According to one of the headquarters staff, there is opportunity for growth in the curriculum, particularly in terms of accessibility and exposure. They hope to not only increase the quality of the curriculum and its content but also ensure that the content is relevant and connecting to the students in meaningful ways. The curriculum development team also seeks to make the curriculum more accessible through providing specialized guidance and support to students who may need it, better serving students who have different learning styles and abilities, and providing support for those with accommodations. Teachers and curriculum managers revealed a couple ways in which accessibility may be improved:

*Facilitate access for all students.* Teachers noted a desire to see more female students in computer science classes and the opportunity for more access for all students. One curriculum manager stated, "I think many of our schools are already doing it, but I think it is important to introduce every student to computer science.… There are some schools [that enroll] every ninth grader or every 10th grader." They explained that strategies like this help to expose greater numbers of English learners to computer science who may not otherwise be exposed.

*Incorporate Spanish language.* Many teachers have made an effort to incorporate Spanish in some way into their lessons, given that for many teachers the majority of their students are Spanish speakers. A couple teachers suggested incorporating more Spanish language into the curriculum or materials for teachers to include around the classroom of math and computer science terminology in both English and Spanish.

**Additional support/training for teachers.** Some teachers, as well curriculum managers, expressed a desire for teachers to have more support in building computer science content knowledge. A curriculum manager suggested a daylong or weeklong training for teachers to expand content knowledge and enhance programming experience. Headquarters staff and curriculum managers also proposed setting realistic expectations for teachers around student learning, classroom management, organization, and tracking of attendance/grades. They noted it is important for school leaders to be aware of and understand the impact of the data-driven

and competitive environment of the charter school network. This competitive aspect has been a challenge for some teachers, with stress and concern about "meeting metrics," which has impacted teacher retention. Curriculum managers expressed a need to provide support to teachers and develop understanding and shared goals across all stakeholders.

### Limitations to Qualitative Data

Although all teachers and headquarters staff were recruited to participate in individual interviews or focus groups as part of the data collection for this portion of the study, only a limited sample of teachers opted to participate during each year of data collection. This may have been due to the lack of incentives for participation in the study, which may have impacted the extent to which teachers were motivated to participate. The small participant sample impacts the extent to which the study's findings can be generalized to the larger population of teachers. Given the limited participant sample, AIR recommends that the findings from this portion of the study be used to supplement and strengthen existing findings from other portions of the evaluation.

## Summary of Findings From Qualitative Data

The benefits of the computer science curriculum implementation include improved access and exposure to computer science for students, free and easy-to-use materials for teachers, and accessible tools and content for teachers with any range of experience or content knowledge.

Challenges faced in curriculum implementing were specific to the BJC curriculum. Teachers of BJC experienced challenges in needing to supplement the BJC materials and frustration in feeling a lack of support in training and guidance on addressing gaps in the curriculum.

Given some of the challenges expressed by teachers in the implementation and use of the BJC curriculum, it is important for IDEA to recognize the limitations of BJC and the need to fill gaps in the curriculum through providing supporting materials, access to additional resources, and additional professional development support for BJC implementation.

Aligned with the recommendation for the math curriculum redesign, there is opportunity to strengthen the implementation process through having training for headquarters staff and leaders to provide more direct exposure to the content for more informed feedback and support. Additional support for teachers in implementing the curriculum, such as modeling or sampling lesson plans more frequently, could also strengthen overall implementation and address challenges in advance.

## Fidelity of Implementation

AIR examined the fidelity of program implementation in 2021–22 and 2022–23 using indicators for three program components. The focus of the fidelity of implementation analyses was to understand the extent to which BJC was implemented as expected, based on program records provided by IDEA and results from teacher surveys (see Box 1).

### Fidelity Measurement

AIR examined IDEA records of program implementation from Years 3 and 4 to generate scores across three components of implementation: release of the AP-CSP curriculum (BJC); teacher training, professional development, and support in using the new AP-CSP curriculum; and teacher use of the new AP-CSP curriculum. For each component, AIR calculated a fidelity of implementation score for each year focused on the occurrence of key program activities. Multiple indicators were examined within each component, with subscores adding up to an overall (program-level) fidelity of implementation score for each component. AIR and IDEA set a predetermined threshold for adequate implementation for each indicator and for each program component (see Exhibit 9 for a list of indicators and thresholds).

**Box 1. Measures of Fidelity of Implementation**

AIR examined fidelity of program implementation in pilot schools using a set of indicators from program records and teacher surveys.

- **Program records** include curriculum development and production tracker, proof of curriculum, and teacher professional development schedules and attendance records.
- **Teacher surveys.** AIR conducted surveys of CS teachers in spring 2022 and 2023 to collect data on teachers' use of curriculum materials and receipt of professional development and support.

### Exhibit 9. Fidelity of Implementation Indicators and Thresholds for Adequate Implementation

| Indicator | Unit of measurement | Indicator scoring at unit level | Indicator scoring at sample level | Threshold for adequate implementation |
|---|---|---|---|---|
| **Key Component 1. Release of AP-CSP curriculum** | | | | |
| (1) IDEA headquarters staff release the Beauty and Joy of Computing (BJC) curriculum materials to computer science principles (CSP) teachers.<br>(Years 3–4) | Program (District) | **(Year 3)**<br>1 = BJC curriculum is released to teachers in 13 treatment schools<br>0 = BJC curriculum is not released to teachers in 13 schools<br>**(Year 4)**<br>1 = BJC curriculum is released to teachers in 2 additional treatment schools<br>0 = BJC curriculum is not released to teachers in 2 schools | Same as unit level | 1 |
| **Key Component 1 total score** | | | Sum of sample-level indicator scores<br>(range = 0–2) | **Adequate = curriculum materials released with a score of 2** |
| **Key Component 2. Teacher training, professional development, and support in using new AP-CSP curriculum** | | | | |
| (2.1) IDEA CSP treatment teachers participate in the BJC training.<br>(Years 3–4) | Teacher | **(Year 3)**<br>1 = 75% or more of teachers in the 13 treatment schools participate in the BJC training<br>0 = less than 75% of teachers in the 13 treatment schools participate in the BJC training<br>**(Year 4)**<br>1 = 75% or more of teachers in the 15 treatment schools participate in the BJC training<br>0 = less than 75% of teachers in the 15 treatment schools participate in the BJC training | Same as unit level | 1 each year<br><br>2 after Year 4 |

| Indicator | Unit of measurement | Indicator scoring at unit level | Indicator scoring at sample level | Threshold for adequate implementation |
|---|---|---|---|---|
| (2.2) IDEA headquarters and campus-based staff provide quarterly training/professional development (PD) to teachers throughout the school year to support pilot curriculum use. | Teacher | **(Year 3)**<br>1 = yes, quarterly training/PD is provided<br>0 = no<br>1 = 75% or more of teachers using new curriculum attend all four quarterly training/PD sessions<br>0 = less than 75% of teachers using new curriculum attend all four quarterly training/PD sessions<br>**(Year 4)**<br>1 = yes, quarterly training/PD is provided<br>0 = no<br>1 = 75% or more of teachers using new curriculum attend all four quarterly training/PD sessions<br>0 = less than 75% of teachers using new curriculum attend all four quarterly training/PD sessions | Same as unit level | 2 each year<br><br>4 after Year 4 |
| (2.3) IDEA headquarters and campus-based staff provide ongoing support to teachers throughout the school year to support curriculum use. | Teacher | **(Year 3)**<br>1 = yes, ongoing support is provided<br>0 = no<br>1 = 75% or more of teachers using new curriculum receive ongoing support<br>0 = less than 75% of teachers using new curriculum receive ongoing support<br>**(Year 4)**<br>1 = yes, ongoing support is provided<br>0 = no<br>1 = 75% or more of teachers using new curriculum receive ongoing support<br>0 = less than 75% of teachers using new curriculum receive ongoing support | Same as unit level | 2 each year<br><br>4 after Year 4 |

| Indicator | Unit of measurement | Indicator scoring at unit level | Indicator scoring at sample level | Threshold for adequate implementation |
|---|---|---|---|---|
| **Key Component 2 total score** | | | Sum of school-level indicator scores (range = 0–10) | Adequate sample score = 10 |
| **Key Component 3. Teacher use of AP-CSP curriculum** | | | | |
| (3) Teachers use the Beauty and Joy of Computing curriculum materials in classes with students | Teachers | **(Year 3)**<br>1 = 90% or more of teachers report on surveys that they used (or primarily used) the new curriculum materials to teach CSP<br>0 = less than 90% of teachers report on surveys that they used (or primarily used) the new curriculum materials to teach CSP<br>**(Year 4)**<br>1 = 90% or more of teachers report on surveys that they used (or primarily used) the new curriculum materials to teach CSP<br>0 = less than 90% of teachers report on surveys that they used (or primarily used) the new curriculum materials to teach CSP | Same as unit level | 1 each year<br>2 after Year 4 |
| **Key Component 3 total score** | | | Sum of school-level indicator scores (range = 0–2) | **Adequate sample score = 2** |

*Note*. Year 3 refers to academic year 2021–22, and Year 4 refers to academic year 2022–23.

## Fidelity Findings

The BJC AP-CSP program met the evaluation threshold for fidelity of implementation for the first key program component (release of the AP-CSP curriculum) in Year 3 but not in Year 4 as the BJC AP-CSP RCT was not conducted in that year (see Exhibit 10).

The BJC AP-CSP program did not meet the evaluation threshold for fidelity of implementation for the second key program component (teacher training, professional development, and support in using the new AP-CSP curriculum) in any year (see Exhibit 10). Specifically, the program fell short of the threshold for Indicators 2.2 and 2.3 (see Exhibit 9) because on average less than 75% of teachers participated in the quarterly training each year.

The program did not meet the evaluation threshold for fidelity of implementation for the third key program component (teacher use of the AP-CSP curriculum) in Years 3 and 4 (see Exhibit 10). Specifically, the program fell short as less than 75% of teachers who responded to the teacher survey in Years 3 and 4 reported that they taught using only the adopted AP-CSP materials or taught primarily with the adopted AP-CSP materials (along with a few other supplementary materials).

### Exhibit 10. Fidelity of Implementation Results by Component in Each Year of Implementation

| Key component | Year 3 | | Year 4 | |
|---|---|---|---|---|
| | Total # of measurable indicators | Fidelity score and whether program met sample-level threshold | Total # of measurable indicators | Fidelity score and whether program met sample-level threshold |
| **Release of AP-CSP curriculum** | 1 program-level indicator | Score = 1<br>**Program fidelity = Yes** | 1 program-level indicator | Score = 0<br>**Program fidelity = No** |
| **Teacher training, professional development, and support in using new AP-CSP curriculum** | 3 teacher-level indicators (*n* of teachers = 30) | Score = 3<br>**Program fidelity = No** | 3 teacher-level indicators (*n* of teachers = 30) | Score = 4<br>**Program fidelity = No** |
| **Teacher use of AP-CSP curriculum** | 1 teacher-level indicator | Score = 0<br>**Program fidelity = No** | 1 teacher-level indicator | Score = 0<br>**Program fidelity = No** |

*Note*. Year 3 refers to academic year 2021–22, and Year 4 refers to academic year 2022–23.

## Conclusion

Although this study found no statistically significant impacts of the implementation of Code.org and BJC curricula on student achievement, engagement in CS, or attitudes toward CS, teachers perceived some benefits to the computer science curriculum implementation. These benefits include improved access and exposure to computer science for students, free and easy-to-use materials for teachers, and accessible content for teachers with any range of experience or content knowledge.

Challenges faced in curriculum implementation were specific to the BJC curriculum. Teachers of BJC experienced challenges in needing to supplement the BJC materials and frustration in feeling a lack of support in training and guidance on addressing gaps in the curriculum. The use of Code.org as a supplement to BJC by treatment teachers may have diluted any impacts of the BJC curriculum. In addition, the BJC curriculum may have presented larger challenges for incumbent teachers who were accustomed to using Code.org. However, generally, the learning curve associated with mastering a new curriculum is a possible reason why we do not observe impacts on students. Given limitations in the fidelity of implementation of BJC, it is important to underscore the limited extent to which the BJC curriculum may have impacted students.

Curriculum implementation is an ongoing and iterative process. Realizing the benefits of implementing curriculum is not always immediate, and it may take more time to achieve desired student outcomes. Examining student performance over the longer term would provide a more complete picture of the effect of the curriculum on student achievement, engagement, and interest in computer science. Implementation of new curriculum requires careful consideration of the needs of teachers and students to ensure that all needs are being met and resources are available for support. IDEA Public Schools recognizes that it is important to provide continued support and resources for teachers (including professional development and training) and an ongoing feedback loop to continue to improve implementation of computer science curriculum. Continuous improvement and consistent supports will contribute to more benefits for teachers and students while moving toward reaching anticipated results and strengthening pathways to the field of computer science.

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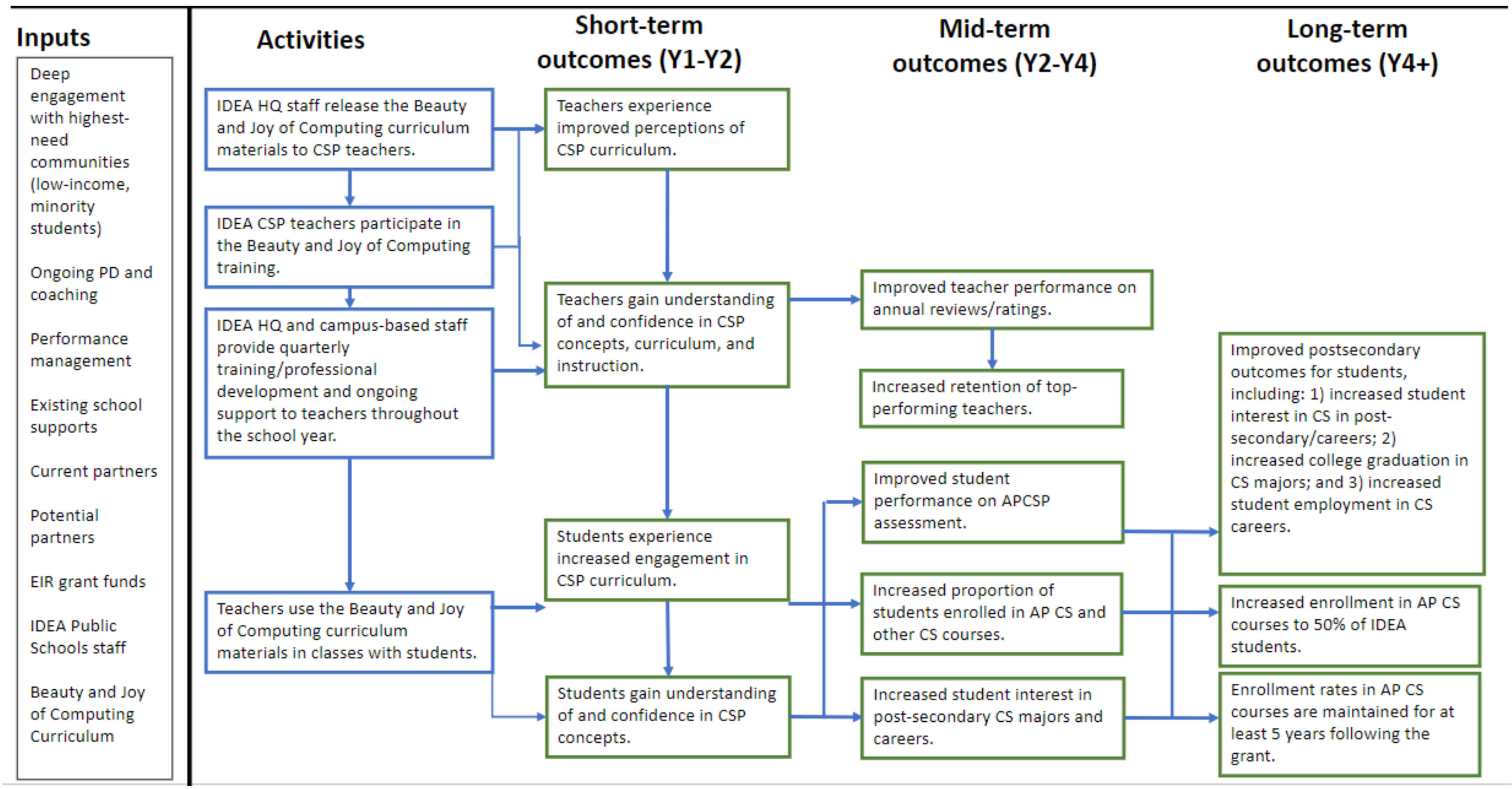
# Appendix A. AP Computer Science Principles: The Beauty and Joy of Computing Logic Model



# Appendix B. Survey Instrument - Reliability Assessment

## IDEA EIR Mathways to STEM Success: Computer Science Principles Student Survey Details

### Exhibit B–1. Student Survey Constructs

| Construct | Items | Cronbach's alpha |
|---|---|---|
| Behavioral | • I stay focused in math class.<br>• I put effort into learning math.<br>• I keep trying even if something is hard.<br>• I complete my math homework on time.<br>• I talk about math outside of class.<br>• I don't participate in class. (rev)<br>• I do other things when I am supposed to be paying attention. (rev)<br>• If don't understand, I give up right away. (rev) | .76 |
| Cognitive | • I go through the work that I do for my math class and make sure that it's right.<br>• I think about different ways to solve a problem.<br>• I try to connect what I am learning to things I have learned before.<br>• I try to understand my mistakes when I get something wrong.<br>• I would rather be told the answer than have to do the work. (rev)<br>• I don't think that hard when I am doing work for class. (rev)<br>• When work is hard I only study the easy parts. (rev)<br>• I do just enough to get by. (rev)<br>• | .74 |
| Emotional | • I look forward to math class.<br>• I enjoy learning new things about math.<br>• I want to understand what is learned in math class.<br>• I feel good when I am in math class.<br>• I often feel frustrated in math class. (rev)<br>• I think that math class is boring. (rev)<br>• I don't want to be in math class. (rev)<br>• I don't care about learning math. (rev)<br>• I often feel down when I am in math class. (rev)<br>• I get worried when I learn new things about math. (rev) | .89 |

| Construct | Items | Cronbach's alpha |
|---|---|---|
| Social | • I build on others' ideas.<br>• I try to understand other people's ideas in math class.<br>• I try to work with others who can help me in math.<br>• I try to help others who are struggling in math.<br>• I don't care about other people's ideas. (rev)<br>• When working with others, I don't share ideas. (rev)<br>• I don't like working with classmates. (rev) | .75 |
| Confidence | • I am confident that I can do an excellent job on tests in this class.<br>• I am certain that I can understand the most difficult material presented in the textbook or course materials used in this class.<br>• I am certain that I can master the skills being taught in this class.<br>• I am confident that I can do an excellent job on assignments in this class. | .91 |
| Interest | • I can usually figure out a way to solve computer science problems.<br>• I find the challenge of solving computer science problems motivating.<br>• I enjoy solving computer science problems.<br>• I am interested in learning more about computer science. | .87 |
| College Intentions | • I will take more computer science classes in college.<br>• I will major in computer science in college.<br>• I will pursue a career in computer science. | .84 |

# Appendix C. Student Survey Instrument

## IDEA EIR Mathways to STEM Success: Computer Science

### Survey Introduction and Assent

The following survey will ask for your feedback about your experiences as a student taking computer science classes in IDEA Public Schools. Your survey responses will be collected by researchers at the American Institutes for Research (AIR).

Your participation in the survey is voluntary, and you may choose to stop taking the survey at any time. Your response is very important to us to learn about your experiences in your computer science class.

Your responses to the survey will be confidential and will not be shared with your teacher or anyone else at your school. Only the research staff at AIR will be able to see your individual responses to the survey. Your name and identifying information about you will not be included in any reports.

This study is not an evaluation of you as an individual. Rather, it is an evaluation of IDEA's computer science classes and student experiences with computer science.

1. **If you understand this information and agree to have your responses included in research by the AIR research team, please select the "agree" box below.**

   ☐ I agree to participate in this survey.

   ☐ I do not agree to participate in this survey.

### Identification

2. **What is your FIRST name? ____________**

3. **What is your LAST name? ____________**

4. **What is the name of your school? ____________**

5. **What is your AP Computer Science Principles Teacher's LAST Name? _________**

6. **What is your date of birth? ____________**

## Computer Science Course Participation

**7. Are you enrolled in any computer science classes this school year (select all that apply)?**

- ☐ Yes, AP Computer Science Principles
- ☐ Yes, another Computer Science class
- ☐ No

**8. Is this the first class in school in which you are learning about the field of computer science and its practices (i.e., learning to write and think about code, understanding computer science tasks and careers)?**

- ☐ Yes, another Computer Science class
- ☐ No

**9. If this is not your first computer science class, what is the name of the class in which you first learned about the field of computer science?**

______________________________________________________________

## Computer Science Engagement

**10.** How much do you agree or disagree with the following **about the computer science class you are currently in now?**

| | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|
| I go through the work that I do for my math class and make sure that it's right. | | | | |
| I think about different ways to solve a problem. | | | | |
| I try to connect what I am learning to things I have learned before. | | | | |
| I try to understand my mistakes when I get something wrong. | | | | |
| I would rather be told the answer than have to do the work. | | | | |
| I don't think that hard when I am doing work for class. | | | | |
| When work is hard I only study the easy parts. | | | | |
| I do just enough to get by. | | | | |

**11.** How much do you agree or disagree with the following statements **about your current AP Computer Science Principles class?**

| | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|
| I stay focused in computer science class. | | | | |
| I put effort into learning computer science. | | | | |
| I keep trying even if something is hard. | | | | |
| I complete my computer science homework on time. | | | | |
| I talk about computer science outside of class. | | | | |
| I don't participate in class. | | | | |
| I do other things when I am supposed to be paying attention. | | | | |
| If don't understand, I give up right away. | | | | |

**12.** How much do you agree or disagree with the following statements **about your current AP Computer Science Principles class?**

| | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|
| I look forward to computer science class. | | | | |
| I enjoy learning new things about computer science. | | | | |
| I want to understand what is learned in computer science class. | | | | |
| I feel good when I am in computer science class. | | | | |
| I often feel frustrated in computer science class. | | | | |
| I think that computer science class is boring. | | | | |
| I don't want to be in computer science class. | | | | |
| I don't care about learning computer science. | | | | |
| I often feel down when I am in computer science class. | | | | |

**13.** How much do you agree or disagree with the following statements **about your current AP Computer Science Principles class?**

| | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|
| I build on others' ideas. | | | | |
| I try to understand other people's ideas in computer science class. | | | | |
| I try to work with others who can help me in computer science. | | | | |

| | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|
| I try to help others who are struggling in computer science. | | | | |
| I don't care about other people's ideas. | | | | |
| When working with others, I don't share ideas. | | | | |
| I don't like working with classmates. | | | | |

**14.** How much do you agree or disagree with the following statements **about your current AP Computer Science Principles class?**

| | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|
| What I learn in this class is useful for everyday life. | | | | |
| What I learn in this class will be useful for college. | | | | |
| What I learn in this class will be useful for a future career. | | | | |

## Confidence and Interest in Computer Science

**15.** How much do you agree or disagree with the following statements **about your current AP Computer Science Principles class?**

| | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|
| I am confident that I can do an excellent job on tests in this class. | | | | |
| I am certain that I can understand the most difficult material presented in the textbook or course materials used in this class. | | | | |
| I am certain that I can master the skills being taught in this class. | | | | |
| I am confident that I can do an excellent job on assignments in this class. | | | | |

**16.** How much do you agree or disagree with the following statements **about computer science in general?**

| | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|
| I can usually figure out a way to solve computer science problems. | | | | |
| I find the challenge of solving computer science problems motivating. | | | | |
| I enjoy solving computer science problems. | | | | |
| I am interested in learning more about computer science. | | | | |

## Computer Science College and Careers

**17.** How much do you agree or disagree with the following statements **based on your future goals?**

| | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|
| I will take more computer science classes in college. | | | | |
| I will major in computer science in college. | | | | |
| I will pursue a career in computer science. | | | | |

**18.** How much do you agree or disagree with the following statements **based on your future goals?**

| | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|
| A career in computer science would enable me to work with others in a meaningful way. | | | | |
| Computer scientists make a meaningful difference in the world. | | | | |
| Having a career in computer science would be challenging. | | | | |

**19. Do you plan to take any computer science classes next year?**

- ☐ Yes
- ☐ No
- ☐ I would take another computer science class, but my school does not offer any others.
- ☐ I don’t know

**20. What grade are you in this year?**

☐ 6th grade
☐ 7th grade
☐ 8th grade
☐ 9th grade
☐ 10th grade
☐ 11th grade
☐ 12th grade

**21. Which of the following categories best describes your race/ethnicity?** [Check all that apply]

☐ American Indian or Alaska Native
☐ Asian
☐ Black or African American
☐ Hispanic or Latino/a/x
☐ Native Hawaiian or Other Pacific Islander
☐ White
☐ Prefer not to answer
☐ Other (please specify)________________________________

**22. How do you identify your gender?**

☐ Female
☐ Male
☐ Non-binary
☐ Prefer not to answer
☐ Other (please specify)________________________________

# Appendix D. Teacher Survey Instrument

## IDEA EIR Mathways to STEM Success: Computer Science Principles Teacher Survey

### Survey Introduction

IDEA Public Schools partnered with the American Institutes for Research (AIR) to conduct an evaluation of IDEA's AP Computer Science Principles curricula and associated supports. As part of the evaluation, AIR is surveying IDEA AP Computer Science Principles teachers who are teaching during the 2023–2024 school year. We are surveying all AP Computer Science Principles teachers, regardless of the curriculum you used, to learn about your experiences teaching AP Computer Science Principles this year.

Your participation in this survey is voluntary, and you may choose to stop participating at any time. Your responses will be sent directly to AIR; IDEA will not see any individual responses. We will treat the data collected during this survey as confidential, and your name and any identifying information about you will not be shared. This study is not an evaluation of any staff member or school; rather, the study is a way to provide information about IDEA's AP Computer Science Principles curricula and related materials for programmatic improvement.

Thank you for your time and for contributing to this important study. If you consent to participate, please click 'Next' to begin the survey.

### Section 1. Curriculum Use and Perceptions

1. Which AP Computer Science Principles curriculum did you use **this** year, 2023-2024?
   - ○ code.org
   - ○ Beauty and Joy of Computing
2. Which AP Computer Science Principles curriculum did you use **three years** ago, 2020-2021?
   - ○ code.org
   - ○ Beauty and Joy of Computing

[Note: From here on, choose code.org or Beauty and Joy of Computing when [code.org/Beauty and Joy of Computing] appears. In the web version, an option is chosen based on the answers to questions 1 and 2.]

3. How often did you use the [code.org/Beauty and Joy of Computing] curriculum materials when you taught AP Computer Science Principles this school year, 2023-2024?
   - I teach only using the [code.org/Beauty and Joy of Computing] materials.
   - I teach primarily with [code.org/Beauty and Joy of Computing] materials along with a few other supplementary materials.
   - I teach with about half (50%) the [code.org/Beauty and Joy of Computing] materials and half (50%) other materials.
   - I teach primarily with other materials and only use the [code.org/Beauty and Joy of Computing] materials to supplement my other, primary materials.
   - I don't use the [code.org/Beauty and Joy of Computing] materials at all in my teaching.

   3a. [Show if used code.org last year] How does the Beauty and Joy of Computing curriculum materials compare to the code.org curriculum materials you have used to teach **computer science (CS) courses**?
   - The Beauty and Joy of Computing curriculum is easier to use than code.org for CS.
   - The Beauty and Joy of Computing curriculum is about the same as code.org for CS in terms of ease of use.
   - The Beauty and Joy of Computing curriculum is harder to use than code.org for CS.

4. How do the [ode.org/Beauty and Joy of Computing] curriculum materials compare to other curricula you have used to teach **CS courses**?
   - The [code.org/Beauty and Joy of Computing] curriculum is easier to use than other curricula for CS.
   - The [code.org/Beauty and Joy of Computing] curriculum is about the same as other curricula for CS in terms of ease of use.
   - The [code.org/Beauty and Joy of Computing] curriculum is harder to use than other curriculums for CS.
   - Not applicable – I've only used code.org and/or Beauty and Joy of Computing
     - Not applicable – I have not taught other CS courses before.

5. Have you used a Computer Science Principles curriculum other than code.org or Beauty and Joy of Computing?
   - Yes
   - No

6. How do the [code.org/Beauty and Joy of Computing] materials compare to **other** curriculum you have used to teach **non-computer science courses**?
   - The [code.org/Beauty and Joy of Computing] curriculum is easier to use than other non-CS curricula.

- The [code.org/Beauty and Joy of Computing] curriculum is about the same as other non-CS curricula in terms of ease of use.
- The [code.org/Beauty and Joy of Computing] curriculum is harder to use than other non-CS curricula.
- Not applicable - I have only used CS curricula.

## Section 2. Preparedness to Teach Computer Science Principles (CSP)

7. Will you teach any Computer Science course(s) in IDEA Public Schools next year?
   - Yes [SKIP TO 8]
   - No
   - Unsure

   7.a [IF NO] You indicated that you will **not** be teaching any Computer Science courses in IDEA Public Schools next year.

   Why not?
   - Teaching courses in another subject instead
   - Leaving IDEA to teach elsewhere
   - Leaving the teaching profession
   - Other (Please explain)__________

8. [IF YES TO 7] How well prepared do you feel to do each of the following in your future (e.g., 2024-25 school year) Computer Science Principles instruction?

| | Not Adequately Prepared | Somewhat Prepared | Fairly Well Prepared | Very Well Prepared |
|---|---|---|---|---|
| Develop students' conceptual understanding of the computer science ideas you teach. | ○ | ○ | ○ | ○ |
| Develop students' abilities to do computer science (for example: breaking problems into smaller parts, considering the needs of a user, creating computational artifacts). | ○ | ○ | ○ | ○ |
| Develop students' awareness of STEM careers. | ○ | ○ | ○ | ○ |
| Develop students' plans to pursue a STEM career. | ○ | ○ | ○ | ○ |

| | Not Adequately Prepared | Somewhat Prepared | Fairly Well Prepared | Very Well Prepared |
|---|---|---|---|---|
| Provide computer science instruction that is based on students' ideas (whether completely correct or not) about the topics you teach. | ◯ | ◯ | ◯ | ◯ |
| Use formative assessment to monitor student learning. | ◯ | ◯ | ◯ | ◯ |
| Differentiate computer science instruction to meet the needs of diverse learners. | ◯ | ◯ | ◯ | ◯ |
| Incorporate students' cultural backgrounds into computer science instruction. | ◯ | ◯ | ◯ | ◯ |
| Encourage students' interest in computer science. | ◯ | ◯ | ◯ | ◯ |
| Encourage participation of all students in computer science. | ◯ | ◯ | ◯ | ◯ |

9. In general, at this point in time, how well prepared do you feel to teach Computer Science Principles in the 2023-2024 school year?
   - ○ Very prepared
   - ○ Fairly prepared
   - ○ Somewhat prepared
   - ○ Not adequately prepared

## Section 3. Classroom Instruction Practices

10. How often did **you** do each of the following in your Computer Science Principles class(es) this year?

| | Never | A few times a year | Once or twice a month | Once or twice a week | In all or almost all lessons |
|---|---|---|---|---|---|
| Explain computer science concepts and skills or demonstrate computer science procedures to the whole class. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Engage the whole class in discussions. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Have students work in small groups. | ◯ | ◯ | ◯ | ◯ | ◯ |

| | Never | A few times a year | Once or twice a month | Once or twice a week | In all or almost all lessons |
|---|---|---|---|---|---|
| Have students do hands-on/manipulative programming activities that do not require a computer. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Have students work on programming activities using a computer. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities). | ◯ | ◯ | ◯ | ◯ | ◯ |
| Have students read from a textbook/online course in class, either aloud or to themselves. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Have students explain and justify their method for solving a problem. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Have students present their solution strategies to the rest of the class. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Have students compare and contrast different methods for solving a problem. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Have students write reflections (for example: in their journals, on exit tickets) in class or for homework. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Focus on literacy skills (for example: informational reading or writing strategies). | ◯ | ◯ | ◯ | ◯ | ◯ |

11. How often do you have **students** do each of the following in your Computer Science Principles class(es) this year? Please consider instructional time only, rather than homework or out-of-class activities.

| | Never | A few times a year | Once or twice a month | Once or twice a week | In all or almost all lessons |
|---|---|---|---|---|---|
| Create computational artifacts (for example: programs, simulations, visualizations, digital animations, robotic systems, or apps). | ◯ | ◯ | ◯ | ◯ | ◯ |

| | Never | A few times a year | Once or twice a month | Once or twice a week | In all or almost all lessons |
|---|---|---|---|---|---|
| Create a computational artifact designed to be used by someone outside the class or other students. | ○ | ○ | ○ | ○ | ○ |
| Provide feedback on other students' computational products or designs. | ○ | ○ | ○ | ○ | ○ |
| Get input on computational products or designs from people with different perspectives (do not include feedback that you give students). | ○ | ○ | ○ | ○ | ○ |
| Systematically use test cases to verify program performance and/or identify problems. | ○ | ○ | ○ | ○ | ○ |
| Identify real-world problems that might be solved computationally. | ○ | ○ | ○ | ○ | ○ |
| Consider how a program they are creating can be separated into modules/procedures/objects. | ○ | ○ | ○ | ○ | ○ |
| Identify and adapt existing code to solve a new computational problem. | ○ | ○ | ○ | ○ | ○ |
| Use computational methods to simulate events or processes (for example: rolling dice, supply and demand). | ○ | ○ | ○ | ○ | ○ |
| Analyze datasets using a computer to detect patterns. | ○ | ○ | ○ | ○ | ○ |
| Write comments within code to document purposes or features. | ○ | ○ | ○ | ○ | ○ |
| Create instructions for an end-user explaining how to use a computational artifact. | ○ | ○ | ○ | ○ | ○ |
| Explain computational solution strategies verbally or in writing. | ○ | ○ | ○ | ○ | ○ |
| Compare and contrast the strengths and limitations of different representations such as flow charts, tables, code, or pictures. | ○ | ○ | ○ | ○ | ○ |

## Section 4. CSP Teaching Efficacy and Beliefs

12. How much do you agree or disagree with the following statements regarding your feelings about teaching Computer Science Principles?

| | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|
| I am continually improving my CS principles teaching practice. | ◯ | ◯ | ◯ | ◯ |
| I know the pedagogical strategies necessary to teach CS principles effectively. | ◯ | ◯ | ◯ | ◯ |
| I am confident that I can explain to students why CS principles experiments work. | ◯ | ◯ | ◯ | ◯ |
| I am confident that I can teach CS principles effectively. | ◯ | ◯ | ◯ | ◯ |
| I wonder if I have the necessary skills to teach CS principles. | ◯ | ◯ | ◯ | ◯ |
| I understand CS principles concepts well enough to be effective in teaching CS principles. | ◯ | ◯ | ◯ | ◯ |
| Given a choice, I would invite a colleague to evaluate my CS principles teaching. | ◯ | ◯ | ◯ | ◯ |
| I am confident that I can answer students' CS principles questions. | ◯ | ◯ | ◯ | ◯ |
| When a student has difficulty understanding a CS principles concept, I am confident that I know how to help the student understand it better. | ◯ | ◯ | ◯ | ◯ |
| When teaching CS principles, I am confident enough to welcome student questions. | ◯ | ◯ | ◯ | ◯ |
| I know what to do to increase student interest in CS principles. | ◯ | ◯ | ◯ | ◯ |

## Section 5. Support to Teach CSP

13. Have you received professional development or other supports for the Computer Science Principles curriculum during the 2023-2024 school year to help your instruction?
    - ○ Yes
    - ○ No [SKIP TO 15].
14. You indicated that you received professional development or other supports for a Computer Science Principles curriculum during the 2023-2024 school year.

    Please describe the professional development or other supports you received.
    - ○ [open ended response]
15. What feedback do you have on your school's current Computer Science Principles curriculum materials?
    - ○ [open ended response]

## Section 6. Background Information

16. Which of the following categories best describes your race/ethnicity? Select all that apply.
    - ☐ American Indian or Alaska Native
    - ☐ Asian
    - ☐ Black or African American
    - ☐ Hispanic or Latino/a/x
    - ☐ Native Hawaiian or Other Pacific Islander
    - ☐ White
    - ☐ Other
    - ☐ Prefer not to answer
17. Please indicate the highest level of education you have completed.
    - ○ Some college, but no degree
    - ○ Associates degree (e.g., AA, AS)
    - ○ Bachelor's degree (e.g., BA, BS)
    - ○ Some graduate or professional education, but no degree
    - ○ Master's degree (e.g., MA, MS)
    - ○ Professional degree beyond Bachelor's degree (MD, DDS, JD, LLB, Specialist)
    - ○ Doctorate degree (e.g., PhD, EdD)
    - ○ Prefer not to answer

18. In what areas do you currently hold an endorsement, certificate, or other teaching credential (select all that apply)?
    - ☐ Elementary core subjects
    - ☐ Middle school core subjects
    - ☐ English
    - ☐ Social studies/humanities
    - ☐ Mathematics
    - ☐ Science
    - ☐ Computer science
    - ☐ Career or technical education
    - ☐ Special education
    - ☐ None
    - ☐ Other ________

19. How much experience do you have (including this year) teaching **any subject** at any grade level?
    - ○ 1 year; this was my first year of teaching
    - ○ 2 years
    - ○ 3–4 years
    - ○ 5–7 years
    - ○ 8–10 years
    - ○ 11 or more years

20. How much experience do you have (including this year) teaching **computer science and/or computational thinking**?
    - ○ 1 year; this was my first year of teaching
    - ○ 2 years
    - ○ 3–4 years
    - ○ 5–7 years
    - ○ 8–10 years
    - ○ 11 or more years

21. In what areas do you teach this school year? Select all that apply.
    - ○ English
    - ○ Social studies/humanities
    - ○ Math
    - ○ Science
    - ○ Computer Science

- Career or Technical Education
- Business
- Special Education
- Other ________

22. Have you ever taught any other AP courses?
    - Yes
    - No [SKIP TO 23]

    22a. [IF YES] You indicated that have taught other AP courses.

    What other AP courses have you taught?

    - [open response]

23. If you would like us to follow up with you about your survey responses, please select one of the "Yes" responses below. If not, please select "No".
    - Yes, via phone call (Please enter your phone number) _________
    - Yes, via text message (Please enter your phone number) _________
    - Yes, via phone call or text message (Please enter your phone number) _________
    - No

You have now reached the end of the survey. If you are ready to submit, please click the 'submit' button below. If you would like to review your responses, you may use the 'previous' button.

# Appendix E. Teacher Survey Tables

### Exhibit E–1. SCREEN1: Which AP Computer Science Principles curriculum did you use this year?

| Prompt | Spring 2022 Count | Fall 2022 Count | Spring 2023 Count | Spring 2024 Count | Total | Pct |
|---|---|---|---|---|---|---|
| code.org | 5 | * | 6 | * | 11 | 24% |
| Beauty and Joy of Computing | 7 | 6 | 7 | 15 | 35 | 76% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–2. LAST_YEAR: Which AP Computer Science Principles curriculum did you use last year?

| Prompt | Spring 2022 Count | Fall 2022 Count | Spring 2023 Count | Spring 2024 Count | Total | Pct |
|---|---|---|---|---|---|---|
| code.org | 6 | * | 8 | 8 | 22 | 63% |
| Beauty and Joy of Computing | 0 | * | * | * | 0 | 0% |
| Neither code.org or Beauty and Joy of Computing | 6 | 7 | * | * | 13 | 37% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–3. Q1: How often did you use the curriculum materials when you taught AP Computer Science Principles this school year?

| Prompt | Spring 2022 Count | Fall 2022 Count | Spring 2023 Count | Spring 2024 Count | Total | Pct |
|---|---|---|---|---|---|---|
| I taught only using the school provided materials. | * | 6 | 5 | * | 11 | 30% |
| I taught primarily with school provided materials along with a few other supplementary materials. | 10 | * | 6 | 10 | 26 | 70% |
| I taught with about half (50%) the school provided materials and half (50%) with other materials. | 0 | 0 | * | * | 0 | 0% |
| I taught primarily with other materials and only used the school provided materials to supplement my other, primary materials. | 0 | 0 | 0 | 0 | 0 | 0% |
| I didn't use the school provided materials at all in my teaching. | 0 | 0 | 0 | 0 | 0 | 0% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–4. Spring 2022 - Spring 2024 – Q2: How does the Beauty and Joy of Computing curriculum materials compare to the code.org curriculum materials you have used to teach computer science (CS) courses?

| Prompt | Total | Pct |
|---|---|---|
| The Beauty and Joy of Computing curriculum is easier to use than code.org for CS. | * | N/A |
| The Beauty and Joy of Computing curriculum is about the same as code.org for CS in terms of ease of use. | 5 | 38% |
| The Beauty and Joy of Computing curriculum is harder to use than code.org for CS. | 8 | 62% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–5. Q3: Have you used a Computer Science Principles curriculum other than code.org or Beauty and Joy of Computing?

| | Spring 2022 | Fall 2022 | Spring 2023 | Spring 2024 | | |
|---|---|---|---|---|---|---|
| Prompt | Count | Count | Count | Count | Total | Pct |
| Yes | * | * | * | 5 | 5 | 13% |
| No | 8 | 8 | 8 | 11 | 35 | 88% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–6. Spring 2022 - Spring 2024 – Q4: How do the curriculum materials compare to other curricula you have used to teach computer science (CS) courses?

| Prompt | Total | Pct |
|---|---|---|
| Curriculum materials are easier to use than other curricula for CS. | * | N/A |
| Curriculum materials are about the same as other curricula for CS in terms of ease of use. | 6 | 55% |
| Curriculum materials are harder to use than other curricula for CS. | 5 | 45% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–7. Spring 2022 - Spring 2024 – Q5: How do the curriculum materials compare to other curricula you have used to teach non-computer science courses?

| Prompt | Total | Pct |
|---|---|---|
| Curriculum materials are easier to use than other non-CS curricula. | 13 | 27% |
| Curriculum materials are about the same as other non-CS curricula in terms of ease of use. | 11 | 23% |
| Curriculum materials are harder to use than other non-CS curricula. | 10 | 21% |
| Not applicable - I have only used CS curricula. | 14 | 29% |

### Exhibit E–8. Q6: Will you teach any Computer Science course(s) in IDEA Public Schools next year?

| | Spring 2022 | Fall 2022 | Spring 2023 | Spring 2024 | | |
|---|---|---|---|---|---|---|
| Prompt | Count | Count | Count | Count | Total | Pct |
| Yes | 9 | 8 | 11 | 14 | 42 | 100% |
| No | * | 0 | * | 0 | 0 | 0% |
| Unsure | 0 | * | 0 | * | 0 | 0% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–9. Spring 2022 - Spring 2024 – Q8_1: Develop students' conceptual understanding of the computer science ideas you teach.

| Prompt | Total | Pct |
|---|---|---|
| Not adequately prepared | * | N/A |
| Somewhat prepared | * | N/A |
| Fairly well prepared | 20 | 51% |
| Very well prepared | 19 | 49% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–10. Spring 2022 - Spring 2024 – Q8_2: Develop students' abilities to do computer science (for example: breaking problems into smaller parts, considering the needs of a user, creating computational artifacts).

| Prompt | Total | Pct |
|---|---|---|
| Not adequately prepared | * | N/A |
| Somewhat prepared | * | N/A |
| Fairly well prepared | 20 | 51% |
| Very well prepared | 19 | 49% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–11. Spring 2022 - Spring 2024 – Q8_3: Develop students' awareness of STEM careers.

| Prompt | Total | Pct |
|---|---|---|
| Not adequately prepared | * | N/A |
| Somewhat prepared | 5 | 13% |
| Fairly well prepared | 16 | 40% |
| Very well prepared | 19 | 48% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–12. Spring 2022 - Spring 2024 – Q8_4: Develop students' plans to pursue a STEM career.

| Prompt | Total | Pct |
|---|---|---|
| Not adequately prepared | * | N/A |
| Somewhat prepared | 8 | 21% |
| Fairly well prepared | 11 | 28% |
| Very well prepared | 20 | 51% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–13. Spring 2022 - Spring 2024 – Q8_5: Provide computer science instruction that is based on students' ideas (whether completely correct or not) about the topics you teach.

| Prompt | Total | Pct |
|---|---|---|
| Not adequately prepared | * | N/A |
| Somewhat prepared | 6 | 15% |
| Fairly well prepared | 18 | 44% |
| Very well prepared | 17 | 41% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–14. Spring 2022 - Spring 2024 – Q8_6: Use formative assessment to monitor student learning.

| Prompt | Total | Pct |
|---|---|---|
| Not adequately prepared | * | N/A |
| Somewhat prepared | 5 | 12% |
| Fairly well prepared | 10 | 24% |
| Very well prepared | 26 | 63% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–15. Spring 2022 - Spring 2024 – Q8_7: Differentiate computer science instruction to meet the needs of diverse learners.

| Prompt | Total | Pct |
|---|---|---|
| Not adequately prepared | * | N/A |
| Somewhat prepared | 6 | 15% |
| Fairly well prepared | 16 | 40% |
| Very well prepared | 18 | 45% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–16. Spring 2022 - Spring 2024 – Q8_8: Incorporate students' cultural backgrounds into computer science instruction.

| Prompt | Total | Pct |
|---|---|---|
| Not adequately prepared | 0 | 0% |

| Prompt | Total | Pct |
|---|---|---|
| Somewhat prepared | 0 | 0% |
| Fairly well prepared | 6 | 38% |
| Very well prepared | 10 | 63% |

### Exhibit E–17. Spring 2022 - Spring 2024 – Q8_9: Encourage students' interest in computer science.

| Prompt | Total | Pct |
|---|---|---|
| Not adequately prepared | * | N/A |
| Somewhat prepared | * | N/A |
| Fairly well prepared | 16 | 43% |
| Very well prepared | 21 | 57% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–18. Spring 2022 - Spring 2024 – Q8_10: Encourage participation of all students in computer science.

| Prompt | Total | Pct |
|---|---|---|
| Not adequately prepared | * | N/A |
| Somewhat prepared | * | N/A |
| Fairly well prepared | 18 | 46% |
| Very well prepared | 21 | 54% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–19. Spring 2022 - Spring 2024 – Q9: In general, at this point in time, how well prepared do you feel to teach Computer Science Principles in the current school year?

| Prompt | Total | Pct |
|---|---|---|
| Very prepared | 24 | 52% |
| Fairly prepared | 16 | 35% |
| Somewhat prepared | 6 | 13% |
| Not adequately prepared | * | N/A |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–20. Q9_1: Explain computer science concepts and skills or demonstrate computer science procedures to the whole class.

| | Spring 2022 | Fall 2022 | Spring 2023 | Spring 2024 | | |
|---|---|---|---|---|---|---|
| Prompt | Count | Count | Count | Count | Total | Pct |
| Never | 0 | 0 | 0 | 0 | 0 | 0% |
| A few times a year | 0 | 0 | 0 | 0 | 0 | 0% |
| Once or twice a month | 0 | 0 | 0 | 0 | 0 | 0% |
| Once or twice a week | * | 0 | 0 | * | * | N/A |
| In all or almost all lessons | 10 | 9 | 9 | 12 | 40 | 100% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–21. Q9_2: Engage the whole class in discussions.

| | Spring 2022 | Fall 2022 | Spring 2023 | Spring 2024 | | |
|---|---|---|---|---|---|---|
| Prompt | Count | Count | Count | Count | Total | Pct |
| Never | 0 | 0 | 0 | 0 | 0 | 0% |
| A few times a year | * | 0 | 0 | 0 | 0 | 0% |
| Once or twice a month | 0 | 0 | 0 | * | 0 | 0% |
| Once or twice a week | 5 | * | * | 5 | 10 | 26% |
| In all or almost all lessons | 5 | 8 | 8 | 8 | 29 | 74% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–22. Q9_3: Have students work in small groups.

| | Spring 2022 | Fall 2022 | Spring 2023 | Spring 2024 | | |
|---|---|---|---|---|---|---|
| Prompt | Count | Count | Count | Count | Total | Pct |
| Never | 0 | 0 | 0 | 0 | 0 | 0% |
| A few times a year | 0 | 0 | 0 | 0 | 0 | 0% |
| Once or twice a month | * | * | 0 | 0 | 0 | 0% |
| Once or twice a week | 5 | * | * | 6 | 11 | 37% |
| In all or almost all lessons | 5 | * | 6 | 8 | 19 | 63% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–23. Spring 2022 - Spring 2024 – Q9_4: Have students do hands-on/manipulative programming activities that do not require a computer.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | 6 | 15% |
| Once or twice a month | 9 | 22% |
| Once or twice a week | 10 | 24% |
| In all or almost all lessons | 16 | 39% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–24. Spring 2022 - Spring 2024 – Q9_5: Have students work on programming activities using a computer.

| Prompt | Total | Pct |
|---|---|---|
| Never | 0 | 0% |
| A few times a year | 0 | 0% |
| Once or twice a month | 0 | 0% |
| Once or twice a week | 5 | 11% |
| In all or almost all lessons | 39 | 89% |

### Exhibit E–25. Spring 2022 - Spring 2024 – Q9_6: Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities).

| Prompt | Total | Pct |
|---|---|---|
| Never | 5 | 11% |
| A few times a year | 8 | 18% |
| Once or twice a month | 8 | 18% |
| Once or twice a week | 9 | 20% |
| In all or almost all lessons | 14 | 32% |

### Exhibit E–26. Spring 2022 - Spring 2024 – Q9_7: Have students read from a textbook/online course in class, either aloud or to themselves.

| Prompt | Total | Pct |
|---|---|---|
| Never | 8 | 19% |
| A few times a year | 6 | 14% |
| Once or twice a month | 6 | 14% |
| Once or twice a week | 7 | 16% |
| In all or almost all lessons | 16 | 37% |

### Exhibit E–27. Spring 2022 - Spring 2024 – Q9_8: Have students explain and justify their method for solving a problem.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | 0 | 0% |
| Once or twice a month | 7 | 16% |
| Once or twice a week | 17 | 40% |
| In all or almost all lessons | 19 | 44% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–28. Spring 2022 - Spring 2024 – Q9_9: Have students present their solution strategies to the rest of the class.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | 5 | 12% |
| Once or twice a month | 9 | 21% |
| Once or twice a week | 10 | 23% |
| In all or almost all lessons | 19 | 44% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–29. Spring 2022 - Spring 2024 – Q9_10: Have students compare and contrast different methods for solving a problem.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | * | N/A |
| Once or twice a month | 8 | 20% |
| Once or twice a week | 12 | 30% |
| In all or almost all lessons | 20 | 50% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–30. Spring 2022 - Spring 2024 – Q9_11: Have students write reflections (for example: in their journals, on exit tickets) in class or for homework.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | 0 | 0% |
| Once or twice a month | 9 | 23% |
| Once or twice a week | 9 | 23% |
| In all or almost all lessons | 22 | 55% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–31. Spring 2022 - Spring 2024 – Q9_12: Focus on literacy skills (for example: informational reading or writing strategies).

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | * | N/A |
| Once or twice a month | 12 | 30% |
| Once or twice a week | 11 | 28% |
| In all or almost all lessons | 17 | 43% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–32. Spring 2022 - Spring 2024 – Q10_1: Create computational artifacts (for example: programs, simulations, visualizations, digital animations, robotic systems, or apps).

| Prompt | Total | Pct |
|---|---|---|
| Never | 0 | 0% |
| A few times a year | * | N/A |
| Once or twice a month | * | N/A |
| Once or twice a week | 10 | 25% |
| In all or almost all lessons | 30 | 75% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–33. Spring 2022 - Spring 2024 – Q10_2: Create a computational artifact designed to be used by someone outside the class or other students.

| Prompt | Total | Pct |
|---|---|---|
| Never | 5 | 13% |
| A few times a year | 7 | 18% |
| Once or twice a month | * | N/A |
| Once or twice a week | 9 | 23% |
| In all or almost all lessons | 19 | 48% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–34. Spring 2022 - Spring 2024 – Q10_3: Provide feedback on other students' computational products or designs.

| Prompt | Total | Pct |
|---|---|---|
| Never | 0 | 0 |
| A few times a year | * | N/A |
| Once or twice a month | 7 | 17% |
| Once or twice a week | 17 | 40% |
| In all or almost all lessons | 18 | 43% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–35. Spring 2022 - Spring 2024 – Q10_4: Get input on computational products or designs from people with different perspectives (do not include feedback that you give students).

| Prompt | Total | Pct |
|---|---|---|
| Never | 7 | 16% |
| A few times a year | 7 | 16% |
| Once or twice a month | 10 | 23% |
| Once or twice a week | 8 | 18% |
| In all or almost all lessons | 12 | 27% |

### Exhibit E–36. Spring 2022 - Spring 2024 – Q10_5: Systematically use test cases to verify program performance and/or identify problems.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | * | N/A |
| Once or twice a month | * | N/A |
| Once or twice a week | 13 | 39% |
| In all or almost all lessons | 20 | 61% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–37. Spring 2022 - Spring 2024 – Q10_6: Identify real-world problems that might be solved computationally.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | 7 | 16% |
| Once or twice a month | 10 | 23% |
| Once or twice a week | 16 | 37% |
| In all or almost all lessons | 10 | 23% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–38. Spring 2022 - Spring 2024 – Q10_7: Consider how a program they are creating can be separated into modules/procedures/objects.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | 5 | 12% |
| Once or twice a month | 9 | 21% |
| Once or twice a week | 12 | 29% |
| In all or almost all lessons | 16 | 38% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–39. Spring 2022 - Spring 2024 – Q10_8: Identify and adapt existing code to solve a new computational problem.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | * | N/A |
| Once or twice a month | 7 | 18% |
| Once or twice a week | 19 | 48% |
| In all or almost all lessons | 14 | 35% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–40. Spring 2022 - Spring 2024 – Q10_9: Use computational methods to simulate events or processes (for example: rolling dice, supply and demand).

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | * | N/A |
| Once or twice a month | 10 | 26% |
| Once or twice a week | 16 | 41% |
| In all or almost all lessons | 13 | 33% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–41. Spring 2022 - Spring 2024 – Q10_10: Analyze datasets using a computer to detect patterns.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | 5 | 12% |
| Once or twice a month | 13 | 31% |
| Once or twice a week | 11 | 26% |
| In all or almost all lessons | 13 | 31% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–42. Spring 2022 - Spring 2024 – Q10_11: Write comments within code to document purposes or features.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | * | N/A |
| Once or twice a month | 7 | 18% |
| Once or twice a week | 8 | 20% |
| In all or almost all lessons | 25 | 63% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–43. Spring 2022 - Spring 2024 – Q10_12: Create instructions for an end-user explaining how to use a computational artifact.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | * | N/A |
| Once or twice a month | 11 | 30% |
| Once or twice a week | 11 | 30% |
| In all or almost all lessons | 15 | 41% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–44. Spring 2022 - Spring 2024 – Q10_13: Explain computational solution strategies verbally or in writing.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | * | N/A |
| Once or twice a month | 5 | 18% |
| Once or twice a week | 12 | 43% |
| In all or almost all lessons | 11 | 39% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–45. Spring 2022 - Spring 2024 – Q10_14: Compare and contrast the strengths and limitations of different representations such as flow charts, tables, code, or pictures.

| Prompt | Total | Pct |
|---|---|---|
| Never | * | N/A |
| A few times a year | 5 | 17% |
| Once or twice a month | 7 | 24% |
| Once or twice a week | 8 | 28% |
| In all or almost all lessons | 9 | 31% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–46. Spring 2022 - Spring 2024 – Q11_1: I am continually improving my CS principles teaching practice.

| Prompt | Total | Pct |
|---|---|---|
| Strongly disagree | 0 | 0 |
| Disagree | 0 | 0 |
| Agree | 16 | 36% |
| Strongly agree | 28 | 64% |

### Exhibit E–47. Spring 2022 - Spring 2024 – Q11_2: I know the pedagogical strategies necessary to teach CS principles effectively.

| Prompt | Total | Pct |
|---|---|---|
| Strongly disagree | 0 | 0 |
| Disagree | * | N/A |
| Agree | 23 | 55% |
| Strongly agree | 19 | 45% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–48. Spring 2022 - Spring 2024 – Q11_3: I am confident that I can explain to students why CS principles experiments work.

| Prompt | Total | Pct |
|---|---|---|
| Strongly disagree | * | N/A |
| Disagree | 0 | 0 |
| Agree | 21 | 49% |
| Strongly agree | 22 | 51% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–49. Spring 2022 - Spring 2024 – Q11_4: I am confident that I can teach CS principles effectively.

| Prompt | Total | Pct |
|---|---|---|
| Strongly disagree | * | N/A |
| Disagree | 0 | 0 |
| Agree | 18 | 41% |
| Strongly agree | 26 | 59% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–50. Spring 2022 - Spring 2024 – Q11_5: I wonder if I have the necessary skills to teach CS principles.

| Prompt | Total | Pct |
|---|---|---|
| Strongly disagree | 11 | 25% |
| Disagree | 18 | 41% |
| Agree | 6 | 14% |
| Strongly agree | 9 | 20% |

### Exhibit E–51. Spring 2022 - Spring 2024 – Q11_6: I understand CS principles concepts well enough to be effective in teaching CS principles.

| Prompt | Total | Pct |
|---|---|---|
| Strongly disagree | 0 | 0% |
| Disagree | * | N/A |
| Agree | 19 | 44% |
| Strongly agree | 24 | 56% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–52. Spring 2022 - Spring 2024 – Q11_7: Given a choice, I would invite a colleague to evaluate my CS principles teaching.

| Prompt | Total | Pct |
|---|---|---|
| Strongly disagree | * | N/A |
| Disagree | * | N/A |
| Agree | 19 | 50% |
| Strongly agree | 19 | 50% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–53. Spring 2022 - Spring 2024 – Q11_8: I am confident that I can answer students' CS principles questions.

| Prompt | Total | Pct |
|---|---|---|
| Strongly disagree | 0 | 0 |
| Disagree | * | N/A |
| Agree | 19 | 44% |
| Strongly agree | 24 | 56% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–54. Spring 2022 - Spring 2024 – Q11_9: When a student has difficulty understanding a CS principles concept, I am confident that I know how to help the student understand it better.

| Prompt | Total | Pct |
|---|---|---|
| Strongly disagree | 0 | 0 |
| Disagree | * | N/A |
| Agree | 19 | 44% |
| Strongly agree | 24 | 56% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–55. Spring 2022 - Spring 2024 – Q11_10: When teaching CS principles, I am confident enough to welcome student questions.

| Prompt | Total | Pct |
|---|---|---|
| Strongly disagree | * | N/A |
| Disagree | * | N/A |
| Agree | 16 | 38% |
| Strongly agree | 26 | 62% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–56. Spring 2022 - Spring 2024 – Q11_11: I know what to do to increase student interest in CS principles.

| Prompt | Total | Pct |
|---|---|---|
| Strongly disagree | 0 | 0% |
| Disagree | 8 | 18% |
| Agree | 19 | 43% |
| Strongly agree | 17 | 39% |

### Exhibit E–57. Spring 2022 - Spring 2024 – Q13: Have you received professional development or other supports for the Computer Science Principles curriculum during the current school year to help your instruction?

| Prompt | Total | Pct |
|---|---|---|
| Yes | 37 | 86% |
| No | 6 | 14% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–58. Spring 2022 - Spring 2024 – Q15: Which of the following categories best describes your race/ethnicity?

| Prompt | Pct |
|---|---|
| American Indian or Alaska Native | * |
| Asian | 0% |
| Black or African American | * |
| Hispanic or Latino/a/x | 54% |
| Native Hawaiian or Other Pacific Islander | 0% |
| White | 46% |
| Other | * |
| Prefer not to answer | 0% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–59. Spring 2022 - Spring 2024 – Q16: Please indicate the highest level of education you have completed.

| Prompt | Total | Pct |
|---|---|---|
| Some college, but no degree | * | N/A |
| Associates degree (e.g., AA, AS) | 0 | 0% |
| Bachelor's degree (e.g., BA, BS) | 24 | 55% |
| Some graduate or professional education, but no degree | 0 | 0% |
| Master's degree (e.g., MA, MS) | 20 | 45% |
| Professional degree beyond Bachelor's degree (MD, DDS, JD, LLB, Specialist) | 0 | 0% |
| Doctorate degree (e.g., PhD, EdD) | 0 | 0% |
| Prefer not to answer | 0 | 0% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–60. Spring 2022 - Spring 2024 – Q17: In what areas do you currently hold an endorsement, certificate, or other teaching credential? Select all that apply.

| Prompt | Total | Pct |
|---|---|---|
| Elementary core subjects | 8 | 15% |
| Middle school core subjects | * | N/A |
| English | * | N/A |
| Social studies/humanities | 0 | 0% |
| Mathematics | 6 | 11% |
| Science | * | N/A |
| Computer science | 8 | 15% |
| Career or technical education | 5 | 9% |
| Special education | * | N/A |
| None | 14 | 26% |
| Other | 13 | 24% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–61. Spring 2022 - Spring 2024 – Q18: How much experience do you have (including this year) teaching any subject at any grade level?

| Prompt | Total | Pct |
|---|---|---|
| 1 year; this was my first year of teaching | * | N/A |
| 2 years | * | N/A |
| 3-4 years | 6 | 18% |
| 5-7 years | 9 | 26% |
| 8-10 years | * | N/A |
| 11 or more years | 19 | 56% |

*Not enough responses to report, less than 5 responses reported.

### Exhibit E–62. Spring 2022 - Spring 2024 – Q19: How much experience do you have (including this year) teaching computer science and/or computational thinking?

| Prompt | Total | Pct |
|---|---|---|
| 1 year; this was my first year of teaching | 8 | 18% |
| 2 years | 7 | 16% |
| 3-4 years | 11 | 25% |
| 5-7 years | 12 | 27% |
| 8-10 years | 6 | 14% |
| 11 or more years | 0 | 0% |

### Exhibit E–63. Spring 2022 - Spring 2024 – Q20: In what areas do you teach this school year? Select all that apply.

| Prompt | Total | Pct |
|---|---|---|
| English | 0 | 0% |
| Social studies/humanities | * | N/A |
| Math | * | N/A |
| Science | 0 | 0% |
| Computer Science | 44 | 75% |
| Career or Technical Education | 9 | 15% |
| Business | 0 | 0% |
| Special Education | 0 | 0% |
| Other (please specify) | 6 | 10% |

*Not enough responses to report, less than 5 responses reported

### Exhibit E–64. Spring 2022 - Spring 2024 – Q21: Have you ever taught any other AP courses?

| Prompt | Total | Pct |
|---|---|---|
| Yes | 17 | 39% |
| No | 27 | 61% |

*Not enough responses to report, less than 5 responses reported.

# Appendix F. Student Survey Tables

### Exhibit F–1. Fall 2021

| | Total | Total N | Treatment | Treatment N | Comparison | Comparison N |
|---|---|---|---|---|---|---|
| Behavioral Engagement | 3.26 | (498) | 3.27 | (236) | 3.25 | (262) |
| Cognitive Engagement | 3.26 | (498) | 3.27 | (236) | 3.25 | (262) |
| Emotional Engagement | 3.12 | (535) | 3.16 | (255) | 3.08 | (280) |
| Social Engagement | 3.21 | (535) | 3.26 | (255) | 3.17 | (280) |
| Confidence | 3.01 | (532) | 3.00 | (255) | 3.03 | (277) |
| Interest | 3.08 | (532) | 3.09 | (255) | 3.08 | (277) |
| Postsecondary Outcomes | 2.80 | (529) | 2.79 | (252) | 2.81 | (277) |

### Exhibit F–2. Fall 2021: Do you plan to take any other computer science classes next year?

| | Which grade are you in this year? | | | | |
|---|---|---|---|---|---|
| **Answer option** | **9** | **10** | **11** | **12** | **Total** |
| I don't know | 112 | 104 | 55 | 49 | 320 |
| I would take another computer science class, but my school does not offer any others. | 11 | 17 | 18 | 7 | 53 |
| No | 37 | 49 | 31 | 57 | 174 |
| Yes | 55 | 71 | 30 | 27 | 183 |
| **Total** | **215** | **241** | **134** | **140** | **730** |

### Exhibit F–3. Spring 2022

| | Total | Total N | Treatment | Treatment N | Comparison | Comparison N |
|---|---|---|---|---|---|---|
| Behavioral Engagement | 3.22 | (359) | 3.19 | (267) | 3.05 | (92) |
| Cognitive Engagement | 3.16 | (359) | 3.24 | (267) | 3.15 | (92) |
| Emotional Engagement | 3.13 | (359) | 3.15 | (267) | 3.09 | (92) |
| Social Engagement | 3.20 | (359) | 3.21 | (267) | 3.17 | (92) |
| Confidence | 3.02 | (353) | 3.10 | (266) | 2.76 | (87) |
| Interest | 3.11 | (353) | 3.15 | (266) | 3.01 | (87) |
| Postsecondary Outcomes | 2.84 | (353) | 2.88 | (266) | 2.74 | (87) |

### Exhibit F–4. Spring 2022: Do you plan to take any other computer science classes next year?

| Answer option | Which grade are you in this year?? | | | | Total |
|---|---|---|---|---|---|
| | 9 | 10 | 11 | 12 | |
| I don't know | 18 | 32 | 14 | 23 | 87 |
| I would take another computer science class, but my school does not offer any others. | 0 | 0 | 12 | * | 12 |
| No | 0 | 38 | 50 | 41 | 129 |
| Yes | 6 | 46 | 20 | 24 | 96 |
| **Total** | **24** | **116** | **96** | **88** | **324** |

*Not enough responses to report, less than 5 responses reported.

### Exhibit F–5. Fall 2022

| | Total | Total N | Treatment | Treatment N | Comparison | Comparison N |
|---|---|---|---|---|---|---|
| Behavioral Engagement | 3.29 | (728) | 3.32 | (424) | 3.23 | (304) |
| Cognitive Engagement | 3.14 | (728) | 3.17 | (424) | 3.11 | (304) |
| Emotional Engagement | 3.18 | (728) | 3.21 | (424) | 3.14 | (304) |
| Social Engagement | 3.19 | (728) | 3.22 | (424) | 3.14 | (304) |
| Confidence | 3.04 | (716) | 3.10 | (418) | 2.95 | (298) |
| Interest | 3.09 | (716) | 3.17 | (418) | 2.97 | (298) |
| Postsecondary Outcomes | 2.81 | (708) | 2.81 | (417) | 2.81 | (291) |

### Exhibit F–6. Fall 2022: Do you plan to take any other computer science classes next year?

| Answer option | Which grade are you in this year? | | | | Total |
|---|---|---|---|---|---|
| | 9 | 10 | 11 | 12 | |
| I don't know | 92 | 89 | 55 | 53 | 289 |
| I would take another computer science class, but my school does not offer any others. | 6 | 13 | 13 | 5 | 37 |
| No | 28 | 49 | 26 | 47 | 150 |
| Yes | 83 | 61 | 64 | 23 | 231 |
| **Total** | **209** | **212** | **158** | **128** | **707** |

### Exhibit F–7. Spring 2023

| | Total | Total N | Treatment | Treatment N | Comparison | Comparison N |
|---|---|---|---|---|---|---|
| Behavioral Engagement | 3.17 | (572) | 3.19 | (193) | 3.16 | (379) |
| Cognitive Engagement | 3.13 | (572) | 3.16 | (193) | 3.11 | (379) |
| Emotional Engagement | 3.12 | (572) | 3.11 | (193) | 3.12 | (379) |
| Social Engagement | 3.16 | (572) | 3.17 | (193) | 3.16 | (379) |
| Confidence | 3.01 | (566) | 2.97 | (191) | 3.02 | (375) |
| Interest | 3.02 | (566) | 2.99 | (191) | 3.03 | (375) |
| Postsecondary Outcomes | 2.81 | (561) | 2.78 | (189) | 2.83 | (372) |

### Exhibit F–8. Spring 2023: Do you plan to take any other computer science classes next year?

| Answer option | Which grade are you in this year? | | | | Total |
|---|---|---|---|---|---|
| | 9 | 10 | 11 | 12 | |
| I don't know | 57 | 39 | 70 | 36 | 202 |
| I would take another computer science class, but my school does not offer any others. | * | 11 | 11 | * | 22 |
| No | 47 | 44 | 37 | 54 | 182 |
| Yes | 36 | 29 | 70 | 13 | 148 |
| **Total** | **140** | **123** | **188** | **103** | **554** |

*Not enough responses to report, less than 5 responses reported.

### Exhibit F–9. Spring 2024

| | Total | Total N | Treatment | Treatment N | Comparison | Comparison N |
|---|---|---|---|---|---|---|
| Behavioral Engagement | 3.09 | (990) | 3.04 | (508) | 3.14 | (482) |
| Cognitive Engagement | 3.05 | (990) | 3.03 | (508) | 3.08 | (482) |
| Emotional Engagement | 2.92 | (990) | 2.84 | (508) | 3.01 | (482) |
| Social Engagement | 3.11 | (990) | 3.07 | (508) | 3.14 | (482) |
| Confidence | 2.84 | (976) | 2.76 | (501) | 2.93 | (475) |
| Interest | 2.85 | (976) | 2.73 | (501) | 2.97 | (475) |
| Postsecondary Outcomes | 2.66 | (968) | 2.60 | (498) | 2.71 | (470) |

**Exhibit F–10. Spring 2024: Do you plan to take any other computer science classes next year?**

| Answer option | Which grade are you in this year? | | | | Total |
|---|---|---|---|---|---|
| | 9 | 10 | 11 | 12 | |
| I don't know | 244 | 62 | 33 | 37 | 376 |
| I would take another computer science class, but my school does not offer any others. | 24 | 8 | * | * | 32 |
| No | 149 | 56 | 19 | 70 | 291 |
| Yes | 109 | 52 | 79 | 18 | 258 |
| **Total** | **526** | **178** | **128** | **125** | **957** |

*Not enough responses to report, less than 5 responses reported.

# Appendix G. AP-CSP Enrollment in 2022-2023

As previously mentioned, the RCT was not conducted in the 2022–23 academic year. However, we obtained data on student enrollment in AP-CSP and their performance on the AP test. Using these data, we calculated some descriptive statistics shown in Exhibit G–1. The treatment group is comprised of high schools that were assigned to the treatment condition during the RCT in 2021–22, and the comparison condition included schools that were assigned to the comparison condition during the RCT in 2021–22.

The results below show that more students enrolled in AP-CSP in schools that were previously assigned to the comparison condition. Enrollment in higher grades (11th and 12th) is higher than in the treatment condition schools. We also found that a higher proportion of students who took the test passed, and had higher scores, in schools that were previously assigned to the comparison condition than students in school that were assigned to the treatment condition. It is important to note that these results are purely descriptive. There are no causal mechanisms causing these patterns.

**Exhibit G–1. Descriptive Statistics on AP-CSP Enrollment, Test Taking, and Test Scores by 2021–22 RCT Study Condition and Grade—Number of Students**

| | All | | 9th Grade | | 10th Grade | | 11th Grade | | 12th Grade | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Treat. | Comp. | Treat. | Comp. | Treat. | Comp. | Treat. | Comp. | Treat. | Comp. |
| Enrolled in AP-CSP | 740 | 830 | 256 | 193 | 268 | 178 | 171 | 234 | 45 | 225 |
| Took AP-CSP Exam | 702 | 659 | 240 | 165 | 250 | 139 | 169 | 184 | 43 | 171 |
| Passed AP-CSP Exam | 127 | 135 | 48 | 29 | 47 | 13 | 28 | 52 | 4 | 41 |
| Average Score on AP-CSP Exam | 1.70 | 1.75 | 1.73 | 1.64 | 1.70 | 1.58 | 1.73 | 2.00 | 1.44 | 1.75 |

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